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GAS LIGHT JOURNAL

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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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BRIEFLY TOLD.

DEATH OF MR. SAMUEL G. STINESS.—The uncertainty of life was never before more shockingly shown than in the appallingly sudden death of Samuel G. Stiness, the Superintendent of the Pawtucket (R. I.) Gas Company, who was killed by a railroad train at the Broad street crossing of the Consolidated Railroad, Pawtucket, on the evening of November 5th. Perhaps the following details of the happening (taken from the Providence *Daily Journal*, of the 6th inst.), will best show how the horrible accident occurred: "He was on his way home, having left the office and arrived at the crossing just as the gates were being shut down. The 5:15 o'clock train out of Providence, driven by Fred. Burgess and under the charge of Conductor Clark, was approaching the station from the south. The crossing tender, George Horton, stood at the gates and noticed Mr. Stiness as he stooped and passed on to the tracks. The crossing is very wide, and it is a very common practice for persons to pass on to the tracks and wait until a train draws into the station. The train was well below the station, and Mr. Stiness evidently thought he had time to cross in safety and continued toward the other side. Across the tracks an electric car was standing and motorman Belknap was on the front platform. Several other persons noticed Mr. Stiness, but being accustomed to seeing many people daily crossing this dangerous place in front of the trains, did not feel greatly alarmed; but they watched his movements with interest. Mr. Stiness hastened his steps when he decided to venture over the path of the swiftly moving train. When near the track he slipped and fell on the wet planking, and struck on his hands and knees. He apparently realized his peril, and in a bewildered manner he started to crawl far enough to escape the train that was swiftly bearing down upon him. But he was doomed and was midway between the rails when the engine struck his body, and in an instant he was under the ponderous locomotive and was crushed to death. The train was stopped about three coach lengths away, and the railroad men commenced searching for the body. It was some time before they found it beneath the engine, and when it was taken out it was found to be mangled beyond recognition." In this horrible manner death came to one who has for more than a quarter of a century occupied a high place in the regard of American gas makers, amongst whom he can justly claim to have been a leader. At the meeting last month of the American Gas Light Association he was honored by an election to the Third Vice-Presidency of that body, an honor which was intended to place him in line for the Presidential succession, as in the years gone by he had been similarly honored by the New England Association, which body held him in its chief executive office for three successive terms—1878, 1879 and 1880. All present at the banquet in Washington will remember how cleverly and with jovial spirit he directed its proceedings from the chair of the toastmaster, and the Guild of Gas Managers all have still fresh in their memories the visit of inspection to the new works of the Waltham (Mass.) Gas Company, on the 3d inst., where the Sage of Pawtucket, as he was lovingly named by his intimates, was as brisk, urbane and magnetic as ever. This meager mention, however, is to be taken only as a prelude to his life's history, which we propose to give at another time in as complete and accurate manner as possible. Deceased was buried from Trinity Church, Pawtucket, on the afternoon of the 8th inst.

[A special message from Pawtucket, received after the above was writ-

ten, brings the news that the funeral services were marked by a large attendance, the gas interest of the country sending at least 50 representatives. The services were celebrated by Archdeacon William P Tucker, the well trained choir of Trinity Church assisting. The honorary pall bearers were Col. Fred. S. Benson, Brooklyn, N.Y.; George B. Neal, Charlestown, Mass.; Charles F. Prichard, Lynn, Mass.; and Col. Jas. H. Armington. The actual bearers were: John Dean, John McLaughlin, Jacob Wise and James G. Noonan, employees at the Pawtucket gas works. The floral offerings were numerous and beautiful, the pieces from the Guild of Gas Managers and the American Gas Light Association being especially appropriate.]

OUR SYNOPSIS OF THE PROCEEDINGS OF THE WASHINGTON MEETING.—With this number we conclude our synopsis of the proceedings of the 22d annual meeting of the American Gas Light Association, and our only regret is that we were unable to give the proceedings in detail as formerly. However, we have managed to give a very fair abstract of that which was said and done, and have endeavored to print the pith of the arguments referred to without doing injustice to any of the speeches that were made. The last papers which were read were those by Mr. H. C. Slaney, of Brooklyn, N. Y., who presented a very interesting compilation respecting one of the first meter makers in the United States; the final one being a treatise on patching holders while in use, by Mr. J. H. Findlay, of Ogdensburg, N. Y. Mr. Slaney's paper is largely on the historical order, and it was with no little satisfaction that its facts and figures were received; for they certainly bear the impress of reliability, since we have been at some pains to verify many of them. The business of the supply of gas on a fairly large commercial scale in America can undoubtedly be credited to Baltimore at the time (1817) noted by Mr. Slaney, and while we can give no accurate figures as to capitalization and price charged for gas at that time, we do know that 43 years later (or in 1860) the Baltimore Company had grown so lustily that it was enabled to pay 10 per cent. dividends per annum on a capitalization of $550,000, the rate per 1,000 for gas being $2.50. We also know that now it is paying 5 per cent. dividends on $11,000,000 of capital, and 6 per cent. interest on $6,400,000 of bonds, while the population of the city is to-day perhaps 500,000, as against a population of 150,000 in 1860, the current gas rate being $1.25 per 1,000. It is true that the gas capitalization of the city has far outpaced the increase in population, and it is also true that the gas rate has only been cut in half; but both of these inequalities are directly chargeable to the fatuous local legislation which prompted and perfected an increase in the gas companies doing business in the city. Of course, this is a digression from our main subject, but it will serve as a reminder, if we compare the business and standing of the gas meter makers of to-day with the business and standing of the meter makers of three-quarters of a century ago, that the former have kept even step with the advance scored in the gas industry of itself. Mr. Slaney well deserved the thanks of the Association for his successful effort in tracing the gas meter making industry of America to its foundation. Mr. Findlay's recital of how he kept a leaky holder up to its work by a judicious system of patching is readable and practical, and we hope it will cause some of the brethren with leaky vessels under their charge to do likewise. The topic of Federation, which was introduced by a report from the Committee (and the Committee was in reality Mr. W. R. Addicks) delegated to frame a Constitution and By-Laws for the government of the proposed Federation, led to a smart debate, the upshot being that the proposal to adopt the report and the recommendations of the Council was negatived by a standing vote of 28 in favor to 29 against. The mere statement of the ballot, however, does not show the actual feeling of the Association towards the proposition, for all the votes in favor were counted, whereas President Pearson declared the motion lost when he had counted a bare majority against. If *all* the votes against were counted, the adverse majority would have been at least 20 per cent. larger. None, however, should lose sight of the fact that Mr. Addicks deserves great credit for the thoroughness of his works in connection with this matter of Federation; and time and money have been freely given by him to the evolution of a scheme that we are bound to say was defeated solely by the belief that it is better to preserve the identity of our Associations rather than to merge them in any sense, no matter how slight the merging decreed. Mr. Brown's plea against Federation is amusing in the extreme to those who remember the history of the matter of reporting the proceedings of the American Association, and as the present state of affairs is chiefly of his own making, it would seem that he ought not to be first to object when the logical outcome of his misdirected politics came to pass. So far as the JOURNAL'S attitude towards the Association is concerned, we believe it is completely capable of managing its own affairs in its own way, and we are prepared to accept its rulings; not only so, but we believe there is a field for the Association *Quarterly* that it will successfully till.

[Concluded from page 656.]

ABSTRACT OF THE PROCEEDINGS OF THE TWENTY-SECOND ANNUAL MEETING OF THE AMERICAN GAS LIGHT ASSOCIATION.

HELD AT BUILDERS' EXCHANGE HALL, WASHINGTON, D. C., OCTOBER 17 AND 18, 1894.

SECOND DAY—AFTERNOON SESSION—Thursday, October 18.

The Association was called to order at 2 o'clock P.M., and the following paper by Mr. H. C. Slaney, of Brooklyn, N. Y., was read:

ONE OF THE FIRST METER MAKERS IN THE UNITED STATES.

The object of this paper is to clearly demonstrate some vague points that have not been touched upon lately, about the earlier workers, as the title suggests, and to furnish a personal and partial history of an almost unknown and unheard of meter manufacturing company, together with that of its founders, known as the "Phœnix" Meter Company, of Baltimore, Md.

There has been very little information published about the earlier manufacturers of gas apparatus in this country. Those hardy pioneers' names should be rescued from obscurity and their memory perpetuated in the archives of this Association, instead of remaining as now in a vale of mystery. The older members of this profession knew of their trials, but for the benefit of the younger members it occurred to the writer that a few rambling notes, gathered at odd times, upon the struggles of one of the first meter makers in this country, would not be amiss, and would help to preserve the names of those who were identified with the early introduction of gas into the United States.

When gas companies first began to organize they were strictly close corporations, and every movement was guarded with utmost secrecy. Therefore, it is almost impossible to gather information in regard to their organizations or modes of working, except from those who were then closely associated with the different companies. In furnishing this mite of history, it has been the writer's fortunate privilege to transmit the inclosed facts from an active worker in the gas industry at the time when meter manufacturing first began here.

From various sources I have gathered the following dates for the several cities, about when they commenced to manufacture and furnish gas for the public consumption. If these dates are incorrectly stated, I hope some member will set me right by furnishing the correct dates. Baltimore, 1817; Boston, 1822; New York, 1823; Philadelphia, 1835; Chicago, 1840; Cincinnati, 1841. The "Gas Light Company, of Baltimore," received their charter February 5, 1816. An ordinance was passed authorizing the Company to lay pipes June 17, 1816. The first public lamp lighting was on February 7, 1817.

The above compilation would make it appear that this was the first successful gas company, and it is now my intention to contend that the city of Baltimore may be called the foster mother of the gas industry, both as to the successful manufacturing of gas and the making of meters, although it was in Philadelphia that gas was first produced and exhibited, by Michael Ambrosie & Co., at their amphitheater on Arch street, between 8th and 9th streets, in the year 1796. It was also successfully attempted several times during a period of about 18 years in that city by other firms. Yet it was not until March 27, 1835, that the Council passed an ordinance for the construction of the Philadelphia Gas Works. They were finished, and the first gas was manufactured February 8, 1836. Gas was also successfully produced, in 1813, by other persons, to be used in lighting mills in Rhode Island and other places.

It may seem evident to you that I have digressed somewhat from my subject, but a portion of the above historical facts will be referred to subsequently in trying to establish the title of this paper. Now let me revert to a period some 62 years ago.

The first meters known to be manufactured in the United States, were made in the city of Baltimore, by Mr. Samuel Hill, about the year 1832 (cannot positively verify the date). The second maker was Mr. John Rodger, also of Baltimore, a machinist, under the supervision of Mr. John M. Slaney, in 1832. The third maker was Mr. C. Young, of New York, in about 1835. The fourth maker was the firm of Colton & Code, of Philadelphia, in about 1839. This firm also made the first station meter.

This is as far as I care to extend the above summary of meter makers in the present paper, for, as stated above, this is merely a personal sketch of one of the pioneers. Mr. John M. Slaney, grandfather of the

Meter Badges of Some of the Early American Makers.

writer, referred to in connection with Mr. Rodger, learned his trade in London, and came to this country in 1829, settling in Philadelphia.

The Baltimore Gas Company imported all their meters from England; the last importation was a small shipment in the beginning of the year 1833. These were all wet meters, and made by Samuel Crosley, of London.

I wish to call special attention to a list of various size meters, together with their prices, published for the first time, to my knowledge. By comparing the list of sizes with that of the present day, you will notice how closely the makers have followed in the footsteps of their predecessors. The only deviation from this list was the 50-light to a 60-light, and the addition of 80-lights. There were a few other sizes which I could not gather information upon at this time. Their selling price, as compared with the present average price, is over 2½ times greater, as per the following :

Size Meter.	Price, 1833.	Price, 1894.
3 lights	$13 88	$5 63
5 "	16 50	7 13
10 "	20 50	9 00
20 "	27 50	12 38
30 "	36 50	16 87
45 "	50 00	24 75
50 "	68 50	33 75
100 "	100 00	56 25
150 "	225 00	86 25

In the year 1832, Mr. John Rodger secured a contract to manufacture 1,000 gas meters for the Baltimore Gas Company, and as Mr. Rodger was not a meter maker, but a machinist, he then proceeded to secure the services of Mr. John Slaney, and persuaded him to go to Baltimore, to equip and superintend his meter shop. He continued with Mr. Rodger in that position for two years.

In the year 1834, at the solicitation of Mr. James Mowton, Secretary of the Baltimore Gas Company, Mr. Slaney entered their service as Superintendent of the meter department. He opened and equipped a shop for supplying the Company with all new meters required, and to repair those that had been in use and set aside for months, in fact some for years. He remained with the Gas Company until 1849.

It has been stated at various times that Messrs. Colton & Code commenced the manufacturing of meters in Philadelphia, during the year 1834. Mr. Code, who was in the employ of Thomas Crosley before coming to this country, was also very well acquainted with Mr. Slaney, and paid him a visit at the gas works in Baltimore, while on a trip to the West from New York in 1838, prior to going into business.

Mr. Colton, of Philadelphia, it has been reported, was a brother-in-law of Mr. Baldwin, of locomotive fame, and had been for some time endeavoring to manufacture meters ; but owing to his inexperience in this line had not succeeded to his satisfaction, when Mr. Code, who was an experienced workman, arrived in Philadelphia on his return trip, and sought out Mr. Colton. Here is an observed difference of four years between these dates.

To substantiate what I have written, I shall quote from the 3d Annual Report of the Trustees of the Philadelphia Gas Works, Jan., 1838. The explicit language used was : "Notwithstanding the desire of the Trustees to procure meters of American manufacture, they found themselves obliged to resort again to England for this year's supply." The number imported in 1837 was 343. Then, again, we shall refer to the 5th Annual Report of the Trustees, January, 1840. It asserts: "The meters furnished by one of our own fellow-citizens, thus far, proved highly satisfactory, and, as yet, there has appeared no reason to doubt that they are equal to those introduced from abroad." The above quotations prove, I think, that Mr. Colton, together with Mr. Code, gave the firm its name and existence about the year 1838 or 1839.

It has also often been stated that the Manhattan Gas Company commenced to manufacture gas meters in the year 1834. This I cannot credit as a certainty, from the assertions set forth by the late Charles Roome, Esq., President Manhattan Gas Company, who stated that he was a junior clerk when Mr. Code was employed to repair meters for his Company. Mr. Roome writes in the AMERICAN GAS LIGHT JOURNAL, under date of Oct. 16th, 1876, that "Theo. Code, of London, was employed by the Manhattan Company to repair the meters for a while, when he joined with Mr. Colton, of Philadelphia, and established the house of Colton & Code, which soon became a strong and highly prosperous establishment." From the above information I should infer that the Manhattan Company did not make new meters, but only did their own repairing in 1834, and for a few years after.

It is my sincere belief that Mr. John M. Slaney (father of the writer) is one of the oldest living gas meter makers in this country, and it is to him that I am greatly indebted for this important historical matter.

He was apprenticed to the meter department of the Baltimore Gas Company in 1837, and left their service in 1839. Re-entered and left their service again in 1848, to begin business for himself.

In this year Mr. John M. Slaney, with Mr. Charles Collier, formed a copartnership to manufacture meters, under the title of Collier & Slaney, Concord street, Baltimore, Md. They continued business until 1850, when they dissolved partnership. Collier & Slaney received a diploma from the Maryland Institute Fair for a "Gas Meter," on the 20th of

November, 1848. It was during this year that they made their first station meter, for the Zanesville (Ohio) Gas Company.

In the year 1850, Mr. Slaney, his father and two other gentlemen, organized the Phœnix Meter Company, No. 44 Holliday street, Baltimore. This Company did splendid work, and the exhibition made by them in the Maryland Institute Fair in 1853 was greatly appreciated; for this exhibit they received a silver medal. This medal, together with several of the above meter makers' badges, are now in possession of writer, and it will afford him great pleasure to show them to members of this Association. The peculiar situation of this city in those days was that it lay upon the border line of the free and slave cities. Goods were bought in the North to be sold in the South; this transaction was the cause of considerable embitterment and jealousy throughout business circles. A merchant, to carry on business successfully, was compelled as a moral suasion to agree with both sides of that, then, live question. Communications between cities were few and far apart. Railroad travelling was quite an undertaking; there were but few trains a day, and tickets purchased at the railroad stations were only good for that specific time and train. Mail delivery, as compared with that of to-day, was so slow that a letter sent with an inclosed bill often found the debtor dead upon arriving at its destination, consequently collections were very hard to make, and, when made, the payments were invariably in "shin-plasters" and "wild cat" bank notes, which, like the "Irishman's flea," when you put your hand on them, their value was not there.

It was a painful positiveness in those days for a person to go to market with a basketful of money (shin-plasters) and a privilege, after continual discounting, to bring home a pound of meat. Note-shaving was quite a profitable business, and it was carried on to perfection.

When the great panic of 1857 swept havoc over the land, the Phœnix Meter Company, with so many of its unfortunate contemporaries, was obliged to fail; not from mismanagement, or the lack of business, or the want of confidence, but from the depressed value of "shin-plasters" and "wild cat" money, and banks demanding triple indorsers on paper, which at certain times was almost impossible to secure.

The Phœnix Meter Company did a prosperous business furnishing meters to gas companies in the principal cities throughout this country and Canada. Some conception may be formed of their flourishing condition, from the following extracts from a book called "Baltimore as It Is," published in 1857. I shall quote only a small portion of that article, and of the part that relates to this subject. "The works of this Company are situated at No. 44 Holliday street, and are divided into several distinct departments, each provided with the most novel and ingenious machinery, worked by steam power, it has ever been our privilege to examine. Indeed, the work is so complicated and regular, as to require the most perfect machines that the ingenuity of man is capable of inventing. The first department we entered was that of the foundry. Here the various brass and iron castings used in the business are made; we noticed among others worthy of note, castings for patterns of the new patent street signs, now used by our city, and a new and handsome style of cock for street-lamp posts. We next passed into the shop where the tin bodies are made for the outside of meters. We next entered the department for making cocks and gas fittings. Following this is a department for getting out brass work for meters. Adjoining this department, is one appropriated to the making of drums, or the interior arrangement of meters. Taken altogether, the gas meter may be regarded as the most wonderful invention the ingenuity of man has ever devised, for while it embraces all the minute and complicated machinery of the watch, it likewise combines the important details in natural philosophy (and this is from a newspaper man). The next department we noticed, was for making movements for meters. This is under the direction of an experienced watchmaker. We here noticed a stationary meter with six dials, with an attachment of an eight day clock. Next following, is a room for making small gas cocks. This department is provided with a rotary shear and heading machine, for cutting and forming heads for meters. After this, comes the department for cutting out work, to do which a number of ingenious machines are used; adjoining, are two small apartments for electrotyping and taking daguerreotype views of meters. In the rear of the lower portion of the building, there is a room for proving meters after they have been finished; they are then taken into the painting room.

"We observed in the course of our visit numbers of beautiful patterns, gotten up in various architectural styles, to go in front of meters. Messrs. Slaney are constantly filling orders, not only for all sections of our country, but for the British Provinces, having acquired a widespread reputation for the beauty, superior mechanical construction, and general correctness of the meters."

Although this Company played an important part in the meter history, and is now out of existence, yet some of its fruit may still exist, for one of its meters was unearthed as late as last year. If my memory serve me correctly, it was removed by Messrs. Helme & McIlhenny, of Philadelphia, from the Lancaster (Pa.) gas works.

John Slaney, senior member of this Company, died in Philadelphia in April, 1863, in his 69th year.

In the employ of the Phœnix Company at that time were two Englishmen, brothers, by the name of Thomas and Harry Tansley. They were clock makers and were employed on movements. Afterward Thomas Tansley associated himself (I think) with Dickey, Baker & Co. This firm started in business on North street, almost directly opposite the Phœnix Company's old stand on Holliday street.

Then, as manufacturer's pamphlets are all effusive with praise for the superior work that is bestowed upon meters of to-day (I appreciate this from a business point of view, and here wish to urge a plea for those old workers), the present makers can advantageously perform an act of kindness by praising the excellent work of those who have passed away. They have left monuments in their wet and dry meters, and have engraved their names to fame upon the badges that adorn the front of every meter of their make.

The early makers did not have the benefit of such splendid machinery that has since been invented and introduced, to aid them in securing excellent work, but their genius was displayed in using all kinds of substitutes to procure some means by which to accomplish their purpose. If these conditions were not a fact, there would not be any incentive to workmen to think out and invent a permanent substitute to supply these wants, and this has been the history from Mr. Clegg's attempt in 1815, to the present "drop a nickel in the slot" meter.

That their workmanship and material were of excellent quality has been verified quite often when exposed to view in repairing meters that have had 40 years of service. This is surprisingly so, when we recall the deteriorating action upon the metal work of foul gases that passed for a purified article.

I have been informed very recently, by a gentleman who has had a varied experience throughout the country, and an excellent knowledge in repairing meters, that the material used in those old meters was better than that often found in some of the meters of to-day, which bespeaks volumes for their judgment in selection of material used.

The leathers in diaphragms of earlier dry meters were often found to be well preserved and in good position, while the metal findings surrounding them were in decay with rust. Comparatively speaking, the leather was as good as new and could have been used over again in new bodies, only this was not considered policy, from the economical point of view.

In concluding, I wish to digress once more by calling your attention to another similarity of ideas that Baltimore must mother—that is, between the use of the first station meter, and I may say that of the last one. As a matter of history, the first station meter used by the Baltimore Gas Company was made by Clegg & Crosley in 1826. It was 48 inches in diameter, by 27½ inches long, out to out. The drum shaft projected from the meter, or at least the gearing attached to the same, and through this medium the motive power was furnished by which the revolving arm in the wet lime purifier was made to turn; this arm kept the cream of lime (water and lime) agitated.

Mr. Hambleton, also of Baltimore, has conveyed, by the use of gear wheels and shafting, the lost power of the meter, to that of his patent oil meter, which is placed upon the top of the hydrogen meter. The conversion of this power, by the utility of his meter, is made to furnish, by the means of dippers, the exact quantity of oil used per 1,000 in the "Wilkinson process."

Mr. Slaney's paper being of a historical nature, there was no discussion.

The paper by Mr. Rathell, on "Some Experiences with the Welsbach Incandescent Gas Lamp," was then read by title, as was also the paper of Mr. Gifford on "Light Wasted in Bad Flames," and that of Mr. Harper on the "Applications of Chemical Technology to Gas Manufacture." As the time for disposal of the remaining business was exceedingly short, the discussion on the above-mentioned papers was recommended to be written and sent in for publication in the *Quarterly* when approved by the Council; and the thanks of the Association were voted to the authors for their papers.

Mr. Loomis' paper, on "The Use of Gas for Other Purposes than Lighting" was disposed of in the same manner, agreeably to his own request, as he was unable to be present to read it.

The President then introduced Mr. J. H. Findlay, of Ogdensburg, N. Y., who read his paper on

PATCHING HOLDERS WHILE IN USE.

When our worthy Secretary wrote me, asking if I would read a paper at our Washington meeting, I was up to my ears in work, repairing an old holder which I had patched many a time before. As I read the letter it struck me at once that patching gasholders while in use might be a good subject for me, particularly as it was worry at that moment; and so here goes. To begin with, the process is very simple, and I hope none of you will ever be placed in the position I was when I first came to Ogdensburg. The Gas Company was poor. It had been in operation 20 years prior to my taking charge, the works much out of repair and no money to make improvements with. The Company owned two gasholders, a new one of 30,000 capacity, built a year before I took charge, and situated about a quarter of a mile from the works. The other was of 60,000 capacity, with a center pole, and a fairly good looking chap for his years, well built and put together. There were a few leaking seams. This holder I decided to keep in use. The old fellow stands only 12 feet from the retort house, is uncovered and therefore exposed to all the storms of our "North Pole" latitude. It had not been properly painted or cared for either. Bituminous matter from the works had fallen on it and rusted it, and there were some leaky seams back of the rivets which had to be repaired. I conceived the idea of making strips, 10 inches wide and the full length of the sheet, and drilling holes 1¼ inches apart, a half inch from the edge, painting the side to be put next the holder with a mixture of red lead, white lead, litharge and boiled oil. Laying the strip on the holder, we drilled through the holes in the new plate into the holder, the holes in the holder being a little smaller than those in the new sheet, so as to allow the screws to pass. We tapped the holes in the holder with a fine thread and screwed the new plate down with round-headed screws, annealing same before using, drawing the new plate up and making a tight joint. I put on 10 or 15 of these strips at that time, and as the holder required I kept putting them on as you would shingle a house until the top side of the holder nearest the works is almost entirely recovered. A new trouble then arose. The sheets along the angle iron began to rust out just behind the rivets, and in order to fasten new sheets to the angle iron I cut the heads off the rivets already in, leaving the plate just as it was. A new plate was cut, formed to the angle iron around the holder and drilled or punched so that the holes would correspond with those already in the angle iron. Then I drove out the rivets with a punch and tapped the angle iron, then following the same process as before.

The sheets on the side also began to rust away from the angle iron as on the top, and I had to put on plates, 15 inches deep and 4 feet long, three-quarters of the way around the holder; and when I get home I am going to finish it all the way around. I am satisfied with them from the fact that the sheets I first put on, about 20 years ago, are tight to-day and will remain so as long as I last. I had a very good test of the strength of the work when I had an explosion at the works last winter. My pumping house and other buildings were blown up in the air. A stone fell on top of the holder and made a tear in it 6 feet long, allowing the gas to escape, and the crown of the holder to resemble an umbrella turned wrong side out. The patches stood the test perfectly.

Having the tools on hand we set to work repairing the break and started to inflate the holder immediately and furnished gas that night from it. The crown resumed its former shape and stands now as proudly as in the days of yore.

Discussion.

Mr. Gifford then related his experience with a holder which had a large hole accidentally punched in its top. He temporarily covered the hole with a canvas and Portland cement plaster, weighted in place till the holder was grounded for more permanent repairs.

Mr. Findlay then exhibited specimens of the patches and photographs of the work, and in answer to a question by Mr. Neal, stated that there would be no difficulty in patching a housed holder—even a rent in the lower section.

The Association then voted its thanks to Mr. Findlay for his paper, and also to Mr. Peter Young for his paper on "A Small Experimental Plant as an Aid to the Management of a Coal Gas Works," which was read by title and the discussion recommended to be written for appearance in the *Quarterly* later.

QUESTION BOX.

The Question Box was then taken up and the Secretary read the questions.

1. "Which is the better pipe for use in services—steel or iron—and why?"

The Secretary said he had been given to understand by people who have used steel services that there was very little choice between steel and iron as far as rusting was concerned.

Mr. Cowdery said that he had used steel pipe exclusively for the last two years, because the inside was smoother than wrought iron pipe, but whether it would last longer he had not had experience enough to state. He thought the steel pipe was cheapest.

Mr. Littlehales asked if the use of steel pipe caused any extra expense in labor for making the joints, and Mr. Cowdery admitted that it did take more labor, and was harder for the die, but there was no appreciable objection on that ground.

2. "Which rusts more rapidly in service use—steel or iron? What kind of yarn is best suited for lead joints—the plain or tarred yarn—and why?"

The President remarked that as steel pipe had been used for so short a time, the first question could hardly be satisfactorily answered.

Mr. Clark said that the company with which he was connected had used steel pipe almost exclusively for three or four years, but that is hardly the life of a service, and not long enough to give any information on that point. He used a preparation for coating the services for protecting them from rust.

Mr. Addicks said that he was experimenting with tarred yarn in lead joints. He thought the advantage was that the joint was less likely to spring back. Joints made with the plain yarn and with the tarred yarn have been perfectly tight in each case.

3. "What kind of yarn is best suited for cement joints—the plain or tarred yarn—and why?"

Mr. Pinkney said he did not think there was any question but that tarred yarn made the best joint because it could be packed so much closer. He had used tarred yarn exclusively for two years, and found that tight joints could be made with it when common yarn would not do.

Mr. Norris mentioned the possibility of the gas dissolving out the tar and leaving the joint leaky.

Mr. McElroy had tried jute and found that it did not answer; and finally used American hemp packing, and one winter when he had 300 broken mains, there was not one pulled joint.

Mr. Clark mentioned that in Jersey City they had discovered evidence of electrolysis where the electrical current in traversing the main passed around the cement joints. In the case of lead joints the current passed through the lead and so there was no appreciable electrolytic action.

Mr. Thompson thought that increasing the resistance of the main by using cement joints was about the best remedy for electrolysis.

Mr. Addicks then recited the case of two mains laid about the same time, one with lead and the other with cement joints, and when taken up the one with lead joints was the one showing signs of corrosion, supposed to be electrolytic.

4. "The Proceedings of the Association being copyrighted, what effect does that have upon papers published therein and read at the meetings?"

Mr. E. C. Brown said the copyright rests in the Secretary of the Association. It cannot be passed to anyone else except in a legal way. It is impossible for anyone rightfully to print those papers without the authority of the Secretary for doing so.

The Secretary explained that such copyright is vested in the Secretary until after the papers have been read and discussed at the meeting. After that is done the Secretary vests the right entirely in the authors of the papers. The Secretary has nothing whatever to do with them after that.

5. "Why are holders built with horizontal side seams made to lap down instead of up on the outside?"

The Secretary remarked that he knew of many cases of the kind, and that if through any cause the joints ever became leaky, it was extremely difficult to make them permanently tight on an outdoor holder in a variable climate without getting at the inside of the holder, as any material worked into the joint would not withstand the contraction of the iron combined with the effects of the gas condensation working down upon it from the inside.

Mr. Mayer thought that if the holder was put together properly at first, the up or down lap of the joints would make no difference.

6. "What should be allowed as a general average for the shrinkage of Lowe water gas in its change from the relief holder through the exhauster, purifiers and meter to the distributing holder, aside from that due to difference in temperature?"

Mr. Clark said that depended largely on whether lime or oxide purifi-

cation was used. If with oxide, the shrinkage should be far less than 1 per cent.

7. "Has anyone used the slide rule principle in figuring the flow of gas through mains? If so, with what satisfaction?"

The Secretary mentioned the Cox Gas Flow Computer, and said that he had found its results to tally very closely with actual practice.

Answers for the other queries were invited for publication in the *Quarterly*, and the Secretary then reported a decision of the Council in regard to the non-publication of one of the papers and the discussion on it, and the action of the Council, by vote, ratified by the Association.

In reply to a question, the Secretary stated that the actions of the Council were in accordance with Article V., Section 17, of the Constitution, viz.: "The affairs of the Association shall be managed by the Council, subject to the control of the general meeting."

By vote the Committee on President's address were instructed to render their report to the Secretary for publication in the *Quarterly*.

Capt. Wm. Henry White then very gracefully called attention to the fact that the widow of the late Geo. A. McIlhenny was in the city, and recommended that the Association send to her an expression of its love and respect for her distinguished husband, and it was immediately and unanimously so voted.

The President then introduced Mr. Addicks to present the report of the Council on Federation.

Mr. Addicks reported as follows: Mr. President and gentlemen of the Association: The Committee on Federation, which was appointed by President Boardman and notified by letter from the Secretary of the Association, met and organized in Boston at the time of the last New England meeting. A plan was drawn up, and the chairman was authorized to invite certain other Associations to appoint Conference Committees to meet the Federation Committee of this Association in Cleveland, in May last. Such letters were sent to members of the Ohio, the Western, the New England, the Pacific Slope, and the Michigan Associations. The chairman received no reply from the Michigan or Pacific Slope Secretaries. Between the sending of the letters and the meeting the time was very short, so that the Pacific Slope Association would have very little opportunity to reply. The Conference Committee met in Cleveland in May, and revised the plan of Federation which had been made by the Federation Committee in Boston. The chairman of the Federation Committee was appointed a committee of one to draw a Constitution and By-laws for the Federation. The Constitution and By-laws (which you will find printed and on the seats in various parts of the hall) is the Constitution and By-laws which was submitted to individual members of the Conference Committees for them to express an opinion upon. The matter was submitted to the Council, and the Council saw fit to submit the whole matter to the Association without any action on their part, except as recommending certain amendments to the report of the Committee, and which the Association might take action on as they saw fit.

The Secretary then read the proposed Constitution and By-laws as amended by the Council.

CONSTITUTION AND BY-LAWS GOVERNING THE PROPOSED FEDERATION.

Article 1.

SEC. 1. The title of this Federation shall be "The Federation of Gas Associations in America."

SEC. 2. The object of the Federation is to further the interests of the gas fraternity and the gas industry.

Article 2.

SEC. 1. Membership in the Feberation is not an individual membership, but is membership by Associations.

SEC. 2. Associations may become members of the Federation only by the unanimous vote of the members of the Federation, except the Associations named in Article 2, Section 3.

SEC. 3. The *New England*, *Western*, *Ohio* and *American Gas Light Associations* may become *Charter Members* of the Federation by accepting at their respective annual meeting occurring prior to June 30, 1896, this Constitution and By-Laws, and by authorizing their Secretaries to sign the same before that date.

SEC. 4. Should any Association fail to pay its proportion of the expenses of the publication of the Journal by June 30 of any year, after 30 days' notice, such Association may be considered suspended from the privileges of membership until the amount has been paid.

SEC. 5. Any Association elected to membership must authorize its Secretary, and he must sign the Constitution and By-Laws before it is entitled to membership.

Article 3.

SEC. 1. There shall be no officers elected by the Federation other than the editor of the Journal.

Article 4.

SEC. 1. Association representation in the Federation shall be by standing committees, members of which are appointed by the Associations in the Federation.

SEC. 2. There shall be a Conference Committee composed of the Presidents, First Vice-Presidents and Secretaries (all ex officio) of all the Associations members of the Federation. The function of this committee is the discussion of the varied events that may be from time to time of importance to gas interests, and that may invite the co-operation of the gas fraternity, thus obtaining concerted action when desirable.

SEC. 3. There shall be a Committee on Standards, Methods and Similar Designs composed of members appointed by each Association in the Federation.

SEC. 4. There shall be a similar Committee on Scientific and Practical Experiments and Investigations.

SEC. 5. There thall be an Advisory Committee on the publication of the Journal, composed of the Secretary (ex-officio) of each Association in the Federation and of the editor of the Journal.

SEC. 6. There shall be a Committee on Audit of Journal Fund, composed of the President of each Association in the Federation or his representative.

Article 5.

SEC. 1. There shall be a Journal, published quarterly, entitled "The Journal of the Federation of Gas Associations in America," containing the annual proceedings of each Association in the Federation, together with committee reports, patents, current literature, new publications and other matters of interest to the Associations or the individuals forming the same.

SEC. 2. There shall be a Journal Fund.

SEC. 3. The cost of publishing the Journal shall be divided among the Associations in the Federation in proportion to their respective total membership, but its cost shall not exceed $2 annually to each member in each Association in the Federation.

SEC. 4. All proceeds from the sale of extra copies of the Journal, advertisements therein, etc., shall be credited to the Journal Fund.

SEC. 5. Each member of the Federation must furnish a copy of its own proceedings, indorsed by its Secretary, for publication in the Journal, and it may copyright its own proceedings.

SEC. 6. The Federation shall not be responsible for opinions expressed or matters contained in the Journal.

SEC. 7. It is intended that every individual member of every Association in the Federation shall receive one copy, and one only, of the Journal.

SEC. 8. Any individual member of any Association in the Federation desiring an extra copy of the Journal shall be furnished same at the price extra copies are furnished to the Associations. All other copies must be paid for as the Advisory Committee may decide.

SEC. 9. The editor of the Journal shall be elected by the Conference Committee. A three-fourths vote of all the Associations in favor of one candidate shall be necessary to secure an election. A unanimous vote of all the Associations at any time may remove the editor from office. The editor's term of office shall be three years or until his successor is elected. The pay of the editor and any clerical assistance the Conference Committee may authorize, shall be fixed by them and paid from the Journal Fund.

The Secretary of the American Gas Light Association shall be the first editor of the Journal.

SEC. 10. On July 1, every year, the Secretary of each Association shall furnish to the editor a list of all its members to be used as a mailing list for the ensuing year.

Article 6.

SEC. 1. Any Association in the Federation through its secretary by communicating with the editor of the Journal, may inaugurate any investigation or movement by this act alone.

SEC. 2. The editor will notify the members of the Advisory Committee of this request, and they in turn will bring the matter before the proper committee and the Council or the Board of Directors of their respective Associations. The data and results should be sent to the editor and should appear in the Journal credited to the proper Association.

After the movement shall have been once started, the committee (having the investigation in charge) of the original Association making request shall develop the lines of the investigation.

SEC. 3. The Association starting any investigation should specify the lines upon which the same should be developed, but this does not prevent investigation on other lines in addition thereto.

SEC. 4. Nothing in this plan is intended to interfere with the independent local government of any Association in the Federation; independent but *co-operative* action on any subject by *each* Association from its *individual* point of view is what is aimed at.

Article 7.

SEC. 1. Each Association in the Federation shall make a provision in its Constitution or By-Laws that a vote may be taken on Federation matters by mail, when its Council or Board of Directors direct the Secretary to obtain such a vote.

Article 8.

SEC. 1. There shall be maintained, by the Advisory Committee, in pamphlet or other convenient form, kept to date from time to time by addenda, a record of all standards adopted by the Federation. This shall be in addition to such matter in the Journal. The date of adoption by each Association of an original standard and the date of any change in same must be plainly shown.

SEC. 2. A charge may be made to members of Associations in the

Federation for each copy thereof, and must be made to all others desiring copies.

Article 9.

SEC. 1. Committees when voting shall vote by Associations, each Association having one vote only.

Article 10.

SEC. 1. This Constitution and By-Laws shall go into effect on July 1, 1896, if accepted at an annual meeting prior to that date by two or more of the Associations named in Art. 1, Sec. 3.

SEC. 2. Changes in this Constitution shall require a unanimous vote of the Associations (each taken at an annual meeting). When there are six (6) Associations in the Federation a three-fourths vote only will be required.

BY-LAWS.—*Article A.*

SEC. 1. Applications for membership in the Federation should be made to the editor, who must promptly inform the Advisory Committee of such application; each member thereof should at once place the application before the Association he represents.

SEC. 2. No Association shall vote on the admission of a new member to the Federation save at an annual meeting.

Article B.

SEC. 1. The members on the Committee of Art. 4, Secs. 3 and 4, representing any Association, should be at least three in number on each committee. Each member should be elected for three years, and the term of office of but one member should expire each year.

Article C.

SEC. 1. When, by a three-fourths vote, the Conference Committee may consider it wise, there may be opened a committee, library and reading room in the city of New York; this shall be for all committees of, or individual members in the Associations in the Federation. A register shall be maintained at these quarters.

SEC. 2. Should this experiment prove successful, one year thereafter, like action may be taken and similar quarters may be established in the city of Chicago.

Article D.

SEC. 1. Changes in these By-Laws can be made by a three-fourths vote of the Associations, but when the number reaches six (6) in the Federation, a two-thirds vote shall be sufficient for such change.

Then followed considerable parliamentary sparring, the report of the Council being adopted, reconsidered, etc., etc. Finally Mr. McKeige took the floor and strenuously objected to the Association spending $800 more on "Proceedings," or going into the publishing business. He thought the Association was getting out of its latitude altogether, and considered that it was due to the *Gas Journals*, as well as to the industry, that these journals be afforded every convenience possible in laying before the gas men the proceedings of the meetings promptly, as well as other papers. He objected to the non-appearance of the report of that meeting until next January, as being too long to wait, and also mentioned that, out of 1,100 gas companies in this country, perhaps 400 of them received the *Quarterly*, because the others were too poor to subscribe for it.

Mr. Brown said substantially that the question was a vital one to him. He was opposed to Federation as then presented because he thought it was entirely beyond the province of such a society, and inimical to the good of the objects of the Association. He believed that not everything emanating from Boston bore the seal of the "Hub of the Universe." Two years ago a paper was read that received much attention. Since then Federation had been dealt with by committees, and now a small minority of members was asked to pass upon it. That he considered unjust to the membership at large. He considered that it would make the Association the entering wedge to a woefully unbalanced scheme which involved unknown sums of money and responsibilities as yet unknown. He objected to the Association engaging in commercial business or inducing other societies to follow—he knew not where. The "regular" gas journals could no longer publish detailed reports of the proceedings of the Association, because the Council had recommended that the papers and discussions should hereafter be published only in the *Quarterly*. He knew of no precedent for such action. In Great Britain and Europe the technical press were without any restrictions as to the proceedings of the societies. He mentioned the long wait expected after the meeting before the appearance of the report in the *Quarterly*, and intimated that admitting advertisements to the *Quarterly* was compelling manufacturers to pay tribute to the Association. He did not think that the authors of the papers believed in the copyright, or that the Council had conceded anything to the press. He believed it was a poor master that said to the good and faithful servant, who had helped him in adversity, "I am now strong and prosperous. You may go!" The Association had reached a fork in its road. One way was a broad, clean, brightly lighted highway; the other a mere crooked trail, ending in chaos. He wished the light of truth to shed rays of justice, fair play and harmony over the discussion of that vital question.

Mr. McIlhenny thought there were two sides to the question. He was against Federation. He wanted the report of the proceedings immediately after the meeting, when the latter was fresh in his mind. He wanted to benefit absent as well as attending members, and also the Western Association, which Federation would prevent, unless they subscribed for the Journal of Proceedings. He thought much was owed to the gas journals and nothing should be done to harm them.

Mr. Addicks asked Mr. Brown to point out the particular things in Federation that he objected to. As he understood the argument of the last two speakers, the weight of their objections was that the gas press could not publish proceedings of meetings of the Federation. He read Article 5, Section 5, showing that each Association would retain absolute control of its own proceedings and could give them to the journals just as they chose, and that the editor of the proposed Journal of Proceedings had positively no power over them.

Mr. Brown said it was not a question of editorship, but he objected, on general principles, and because a gas association had no right to engage in any commercial business; and also because of a most unusual proceeding that day, in the withdrawal of a paper. He thought it was knifing the gas journals in the back.

Mr. Addicks understood that Mr. Brown's chief objection was that the journals would not have the entire proceedings of one or more of the Associations, but it was not so provided or intended in the Constitution and By-Laws. He also explained that if Federation became a fact the *Quarterly* would, of course, be discontinued and thus the cost of publishing the proceedings of the American Association would be $200 less than at present, instead of $1,000 more, as claimed by Mr. McKeige.

Mr. McDonald did not agree with Mr. McIlhenny altogether on the subject of Federation, and did not quite agree with the arranagement proposed. He thought the arguments so far adduced, to be of no importance, as not bearing upon the really important points of the scheme. He believed that the upholders of Federation were honest in purpose, and worked, as they believed, for the good of the Association and the fraternity. The project should be discussed on the ground of its probable effect on the usefulness of the Association. He believed that the educated technical members would derive more benefit from Federation than the others. He did not think that the journals, or a few dollars of expense, should be the only considerations. He thought it was discouraging that some of the papers had been passed over hurriedly because somebody wanted to discuss Federation.

Mr. Littlehales thought that, as each author controlled his own paper after it had been presented at the meeting, there was no objection on that score unless the writers should choose to withhold them from the journals.

Mr. Fodell thought it all very indefinite and wanted the subject laid over a year. Then followed more parliamentary sparring, and Mr. Brown moved to adjourn, but withdrew his motion, which was loudly objected to.

Mr. Harbison protested against the Association being ruled by representatives of two or three gas journals, and was ready, with others, to form an Association of nobody but gas men engaged in the business. He objected to parliamentary tactics being used to cut off discussion. He hoped it would be fully discussed and acted on, as he was opposed to postponement.

Mr. Lansden thought it should be postponed, so as to allow time for discussion and to ascertain the feelings of the other Associations on the matter.

Mr. Addicks argued against postponement.

The President then closed discussion by putting the motion to postpone, and it was lost. A motion was then made, seconded and put, to adopt the report of the Committee and the recommendations of the Council, and the motion was lost by a standing vote of 29 to 28.

The Secretary, who was then given the privilege of the floor, said that as the *Quarterly* was entirely under the control of the Association, the report of the meeting could be issued the next week, instead of next January, if a majority of those present said so. As for the subject of Federation being passed upon by a minority of the membership, they could take a mail vote, in which every member would have a ballot, if they desired to do so. He thought the gentleman from New York labored under a serious misapprehension, for if that gentleman understood the plan of Federation at all, he would know that it provided for pooling the expenses of publishing the proceedings of the several Associations and so reduce the cost to each one below what was possible for any one independently at present. He then showed a copy of the

"Journal of the Association of Engineering Societies," and stated that that was a fair example of what it was desired to accomplish in the matter of form of proceedings, and as that journal was in its 13th volume, the plan was no experiment, but a well tried and proven one. As far as the matter of publishing the proceedings was concerned, the Association of Engineering Societies afforded a most satisfactory precedent. If Federation became a fact, the publication of the American's proceedings would cost them $100 or $200 less than at present, for no sensible man would seriously believe for a moment that the *Quarterly* would then be continued. The member who knew not where Federation would lead to surely had but a very indistinct idea of it. There were but two essential points in it, and the one word co-operation expressed it all—co-operation in professional technical investigations and co-operation in the publishing of proceedings in permanent form. He revered time-honored customs, but if they exclusively were adhered to civilization would be at a standstill. It had been said that tribute would be extorted from the manufacturers—that could refer to nothing else than advertisements. No one was compelled to advertise. He would not place his advertisement next to that of his competitor, if nothing was to be gained by it, and if he placed it where nothing was to be gained by it, it must be for sentimental reasons, and such are not sufficient to cause a business man to unnecessarily bleed his wallet. As for the *Quarterly*, it spoke for itself, and the Association could simply by vote stop any feature, or the whole of it, if it was not worth having. The relation of the matter to the gas press was a very serious problem. The leading point was whether the Journal of Proceedings would publish something that the gas press would not. While he favored, individually, the publication of the proceedings in the gas press, he considered it to be a small fraction of their valuable matter, which if not given them, they would, as business men, replace with other valuable matter, and so increase the value of their papers to the members. He believed that the field of the gas press was small, and they should be supported, but it was to be supposed that certain limitations on the publication of proceedings would enhance the value of membership. He mentioned two papers printed in the *Quarterly* because of value for reference, and one other received from a non-member upon request. He thought the members did not appreciate the difficulties of getting papers early enough for printing in proper time before the meeting, no matter in what form issued. The *Quarterly* was not responsible for any delay, but had prevented it being more serious, as it was a great help in getting the papers both in points of number and time. From the tenor of the remarks of a previous speaker he felt that that discussion was, on some points, almost of a personal trend, in the way in which it was implied that somebody was trying to load the Association with a scheme pledging it to the expenditure of unknown sums of money. He did not wish to allow any personal feeling to enter the matter, and as for his relations to the *Quarterly*, or the proposed Journal of Proceedings, he was not anxious for the office. He had enough work, and there was no money in it for him. The *Quarterly* was the result of his execution of instructions received from the Council, which he had carried out the best he knew. He was ready to resign and let somebody else take the place, thus relieving him of the strain of having a fight behind the scenes with any of the editors of the gas journals.

After more parliamentary sparring over the general subject, Mr. Shelton said that last year the Secretary had hoed the hardest row that any year afforded, and that he had executed a great work, which stood not for his own personal opinion but represented the instructions he had received from the Council, wherefore Mr. Shelton thought it extremely ill-fitting in the Association to adjourn without voting him its thanks, which it accordingly did by a rising vote.

Mr. Harbison then, with very fitting remarks, proposed a vote of thanks to President Pearson, for his execution of his duties. The question having been put by the Secretary, it was unanimously so voted.

President Pearson feelingly responded, expressing his pleasure at the honor conferred upon and the courtesy shown him, and his gratification at the consideration shown the British members by placing their flag besides the star and stripes, closing his remarks with best fraternal wishes. The Association then voted to send a message of sympathy to Col. Joseph R. Thomas, who was confined at home by illness.

Mr. Graeff then offered a resolution that no paper be read before the Association unless previously published in the *Quarterly*.

Mr. Littlehales thought the resolution should be that the papers should all be read by the Council before being presented to the Association.

After some discussion by the last two speakers the Secretary announced that he would in future, whenever possible, be only too glad to have the papers read before or by every member of the Council before being published for or read at the Association meetings. That being satisfactory, the resolution was indefinitely postponed.

The Committee of Arrangements were then thanked by vote, as also were the Federation Committee for the very intelligent way in which they had conducted their arduous labors.

Mr. Addicks having expressed his satisfaction that the plan of Federation had not been adopted by a *close* vote, the Association then adjourned.

Applications of Chemical Technology to Gas Manufacture.[1]

By Mr. Geo. H. Harper, of Altoona, Pa.

I have not presumed to write on this subject because of any special or peculiar knowledge I possess, or my ability to treat the matter exhaustively, or even adequately; but simply from a belief that the science of chemistry, in its relation to gas manufacture, does not receive among the rank and file of our profession, that attention which it merits.

The birth of modern chemistry and gas manufacture may be said to have been simultaneous, both occurring in the closing years of the last century. But just as the former science has made great and rapid strides sinces the days of Priestley, Cavendish and Lavoisier, so are the processes of the latter radically different in their refinements from those employed by Murdoch, Clegg and Melville—the progress made in gas manufacture being but the outcome and reflection of that made by chemistry; and I believe it is true to-day that, just in the proportion that we are masters of chemical philosophy, will we be experts in gas manufacture, in the widest and best sense. The time has gone past in gas making, as in most other large industries, when mere mechanical knowledge (however good in itself) avails a man in making the most of himself or the business committed to his care, and he has become the "practical" man who has the keenest appreciation of the nature or properties of the raw materials he handles, and is taught by that finer perception to adopt these methods and appliances that will best develop their inherent possibilities.

A mere enumeration of the materials we handle will convince the least thoughtful of the inestimable value of chemical technology for their proper understanding and valuation. We have coal, oil, tar, ammoniacal liquor, lime, oxide of iron and gas, all compound bodies, which, in their interactions, give rise to many others the nature and properties of which it is essential we should know, and to unlock the constitution of which chemistry furnishes the only key.

Of the many enigmas presented to the gas manufacturer of to-day, it is necessary only to mention a few to show how extended still is the field for research. What is it tar? And can any or all of its contained hydrocarbons be retained in a permanently gaseous form? Of what is our condenser and scrubber liquors composed? And what relationship exists between this composition and that of the crude gas, or the efficiency of condensing and scrubbing in relation to the purifying boxes and the purifying account? What are the substances entering into that complex substance we, in our ignorance, call, "waste lime," and what the exact nature of the actions and interactions that have produced them? How do the practical results obtained in the use of lime agree with theoretical possibilities? And what is the precise nature and cause of loss, if any, and the remedy? What are the chemical or physical conditions best fitted to secure the maximum results from oxide of iron? And whether the highest efficiency is most dependent on a chemical or physical condition? How is efficiency affected by temperature, and what is the best temperature for any given condition of working? What are the constituents of our gas that most contribute to its luminosity? And how can the maximum of these be produced and retained?

I venture to say that the man who will thus intelligently question his apparatus and materials will acquire a higher and finer conception of, and deeper interest in, his chosen profession. Let me select as the first illustration of the uses of chemical technology in our business, coal—the commonest as well as the most important material in a gas works. As every coal placed upon the market is not suitable for gas making, we have, therefore, to make a selection. On what principle are we to do it? Evidently we cannot test practically every coal that may be offered us; that would be as foolish as disastrous. Yet how often do we find that certain kinds of coal are preferred to certain

1 Prepared for the Twenty-second Annual Meeting of the American Gas Light Association, and printed in the JOURNAL by permission of the author.

others, after years of just such practical testing, when a little technical knowledge would have demonstrated at the start that those finally selected were the best.

I am aware that analyses of coal have been decried because of discrepancies among the analyses themselves, and also because of great discrepancies between many published analyses and practical results. For the first part of the complaint there is, unfortunately, some basis of truth. This arises, mainly, from lack of uniformity in methods of securing samples that are fairly representative of the coal; in the care to secure uniform conditions as to moisture; and, in part also, from different modes of conducting an analysis. Regarding the last part of the complaint, a wide divergence between analysis and working results does not always argue that the analysis is wrong or misleading, but that the manufacturing conditions are not such as to give results closely approximating to theoretical possibilities. It is a well known fact that the same coal will yield very different results in different works, the result being affected by size and condition of retorts, heats, exhaust, and a variety of other conditions.

An analysis of coal may be either "proximate" or "ultimate," the former giving information as to a few salient points, such as moisture, volatile matter, fixed carbon or coke, ash and sulphur; the latter affording complete detail as to the elementary constituents of the coal.

By means of a proximate analysis we can forecast with reasonable accuracy what amount of gas we will obtain from a given coal, the amount of coke and its quality, and also the probable cost of purification as determined on the sulphur found. An ultimate analysis, in addition to giving the foregoing information, would, by showing us the relative amounts of hydrogen and oxygen present, enable us to approximate closely to the probable candle power.

Many things have to be considered in the selection of a coal, such as first cost, transit of gas, quantity and quality of residuals and an available market for them, and labor charges.

Having by the aid of chemistry selected our raw material, let us turn our thoughts for a little while to the gaseous products of its distillation and see to what extent this science will aid us in understanding their constitution and the best and most economical methods for their manipulation.

Coal gas as it leaves the retort is a very complicated body, containing a variety of substances which the gas manager endeavors to keep in a permanently gaseous form, accompanied by others for the elimination of which his utmost skill and care are demanded in order that the work may be done with efficiency and economy.

Owing to the many influences which are operative in affecting the constitution of coal gas as it leaves the retort, and the very different mechanical and other conditions obtaining at different works, it is impossible to give any formula that would be in any sense generally representative. The constitution of the gas as it is delivered into the hydraulic main having then passed beyond our control, and our objective being the very best attainable conditions in our finished product, it remains only to avoid subsequent deterioration from the methods and means employed for the removal of those ingredients in the gas regarding the necessity of the removal of which there is a general agreement.

The first point which naturally engages our attention in dealing with the crude gas is condensation. Condensation is effected by both chemical and mechanical means; chemical, in so far as a lowering temperature permits of the exercise of those selective affinities which exist among the elementary and compound bodies composing the gas; mechanical, to the extent that matter carried in suspension is removed by simple friction. The gas leaves the retort at a very high temperature, but condensation begins immediately; a marked difference in temperature being observed between the ascension or stand-pipes and that of the retorts.

A large part of the heavier tarry matter thus condensed out never travels beyond the hydraulic mains, and if proper care be not exercised there may also be deposited a considerable amount of valuable light-giving matter, through the absorption by the tar of certain of the heavier hydrocarbons we desire to retain in a gaseous form.

The effort to prevent this absorptive action has given rise in modern times to the practice of removing the heavier tars practically as soon as produced, leaving the dip pipes (where dips are used) sealed as far as practicable in ammoniacal liquor only.

If it be admitted that coal gas is mainly, a body of marsh gas, carrying in suspension certain hydrocarbons which, by virtue of their original constitution or that acquired through the interactions of combustion, give it luminosity, the following somewhat typical analysis of tar will show the importance of avoiding the absorption just mentioned:

Carbon	77.53
Hydrogen	6.33
Nitrogen	1.03
Sulphur	0.61
Oxygen	14.50
	100.00

Coal tar is simply a body of condensable hydrocarbons. If, therefore, the luminous value of the gas depends on the amount and constitution of those compounds carried, a glance at the above analysis will show the practically endless series of such that may be obtained from tar by methods which the future will certainly develop, if they do not now exist.

In condensation, time is of the utmost importance; the more gradual the cooling of the gas, the better the results obtained. Should the same ultimate temperature be attained by rapid and violent methods as by slow and more careful methods, the almost inevitable consequence will be the liquefaction or solidification of some of the light-giving matter in the gas, which it should be our aim to maintain in a gaseous condition. I need only mention that "thorn in the flesh," naphthaline, to impress the necessity for care at this point.

Condensation, it seems to me, offers a rich and wide field for cultivation by means of systematic analysis of the gas at its various stages, and the intelligent and persistent use of thermometers. The data thus collected would be invaluable for comparison with that obtained from other points in our operations to show the effects of changing conditions and the relative values of different methods of working.

In scrubbing and washing, success depends absolutely on the free exercise of selective chemical affinities and the varying degrees of solubility in water of the compounds so formed, or the absorptive action they mutually exert upon each other. Here, too, temperature plays a conspicuous part, accellerating or retarding the interaction of the molecules and affecting the solubility of the gases formed in the solvent employed.

So far, our operations have relieved us of all tarry vapors, and practically the whole of the ammonia, while the other impurities have been reduced to a limit as low, presumably, as ordinary apparatus used in the ordinary way can reduce them; and having arrived at the principal part of our purifying plant, we will consider the work of the lime and oxide boxes.

This is the point, speaking generally, to which our chief efforts are directed in order to secure the maximum results in purification with the minimum expenditure in labor and materials. I will therefore, with your permission, give somewhat closer attention to this department, reviewing the commonly accepted reactions in detail, and dealing with the lime boxes first.

Where gas first enters a lime box there is a simultaneous formation of carbonate and sulphide of calcium, which compounds continue to be formed until all the calcium in the lime has entered into chemical combination in one or other of the above forms. While the above is true theoretically, we know that in actual practice the lime is never wholly used up. This arises mainly from two causes—a failure to secure in preparation just that degree of moisture and general fitness of condition to realize the highest result, and also that the methods of purification in general use compel us to remove the lime when our boxes show a foul test, regardless of whether the lime has been completety saturated or not.

When CO_2 and H_2S have been absorbed until the seeming saturation point has been reached, conditions change, and the stronger affinity of slaked lime for CO_2 and H_2S comes into play, the CO_2 displacing the H_2S and allowing it to pass off in the free condition, as shown by the following equation:

$$CaS + CO_2 + H_2O = CaCO_3 + H_2S.$$

Slaked lime will free the gas completely from CO_2 and H_2S, but has no effect whatever on the bisulphide of carbon.

No chemical affinity exists between lime as calcium hydrate and the bisulphide impurity, but as the hydrate becomes, by the continued absorption of sulphureted hydrogen, converted into calcium sulphide, then chemical action takes place between the sulphide and the impurity in question; thus:

$$CaH_2O_2 + H_2S = CaS + 2H_2O$$
$$CaS + CS = CaS, CS.$$

In other words, "foul lime," as we are accustomed to call it, does what clean lime will not do.

This may appear strange at first sight, but is not more really so, when regarded chemically, than that CO is a highly inflammable gas, whereas CO_2, containing but one more atom of oxygen, is neither combust-

ible nor a supporter of combustion. The two compounds of calcium we are considering are as radically different in their nature and properties as are the two carbon compounds.

Considerable stress is ordinarily laid upon this ability of foul lime to absorb CS, and elaborate arrangements of boxes have been advocated or employed to take advantage of it, often without a full and clear appreciation of the facts. CaS is known as the mono-sulphide of calcium; and we have been taught that only when in this condition does it have the power to absorb bisulphide of carbon. That is to say, the higher or polysulphides have no affinity whatever for the bisulphide impurity, or if they have it is of such an utterly feeble and unreliable nature as to preclude any dependence being placed upon it.

Within recent years some modifidation of this opinion or theory has taken place, and to-day there are in operation processes which depend for their success on the power of polysulphides to absorb the bisulphide of carbon impurity. Very considerable light has been shed on this question by the researches of Hood and Solamon in England, whose experiments show that, while the common result of passing gas through a lime box is the simultaneous formation of carbonate, theocarbonate and sulphide of lime, heat is a very important factor in promoting and modifying the formation of all three.

This influence of heat is made manifest by the results obtained from passing CO_2 into a hot or cold solution of lime. The resulting compounds, while alike in their chemical constitution, are totally unlike in their chemical activities. The same is true of sulphide of lime; great differences in results being apparent according as the sulphide has been prepared from a hot or a cold solution.

The rate and completeness of the evolution of H_2S from sulphide of lime by the introduction of CO_2 depend entirely upon the temperature at which the sulphide has been prepared and maintained. If cold, the expulsion is slow and incomplete; if hot, rapid and thorough, leaving in the latter case pure carbonate of lime.

Another result of these experiments was to show that the relative values of the two compounds, prepared in the manner indicated, for the absorption of the bisulphide impurity, was 30 per cent. higher in that prepared from the hot solution than the other; and, further, that a sulphide box once chilled, never regains its former efficiency by about 50 per cent. In this same connection may be mentioned the well-known fact that if enough H_2S has been passed through a lime box to produce the monosulphide only, the absorption of CS is very feeble. Let this same material, however, be taken from the box and exposed to the atmosphere, and it is found to have a much stronger affinity for the bisulphide impurity than before.

That a chemical change has taken place in its constitution is made evident by its change of color and its deportment with reagents before and after oxidation; giving, with salt of lead, a black precipitate in the former, and a red crystalline deposit in the latter case.

The feeble action of the monosulphide may be due, in part, to small volumes of air drawn through defective joints or open retorts by the exhauster, as well as a slight excess of air—where air is employed for the continuous revivification of oxide—which, finding its way to the special sulphide box beyond, leads to the formation of hyposulphites, which Messrs. Hood and Solamon have demonstrated are useless for the elimination of bisulphide of carbon.

When lime alone is used for purification with the ordinary arrangement of boxes, the best theoretical conditions are difficult, if not impossible, of attainment. In the majority of cases the frequent changes necessary do not give sufficient duration of contact for the development of maximum chemical action—this being further complicated by the continued disturbing action of carbonic acid.

Oxide of iron, which will now engage our attention for a little, as commonly used in gas works, is either natural—dug from the earth, where it abounds in certain districts as an ore—or is artificially prepared. In the former condition it is invariably accompanied by a greater or a less amount of earthy matter which is inert and useless for the purpose of purification; although, to some extent, playing the same part as does shavings or sawdust in the artificial product. Oxide of iron is valueless for the removal of ammonia, carbonic acid, and bisulphide of carbon; sulphureted hydrogen being the only impurity for which it exhibits any affinity.

The reaction between oxide of iron and H_2S is shown by the following equation:

$$Fe_2O + 3H_2S = 2FeS + S + 3H_2O,$$

the products being ferrous sulphide, free sulphur and water.

The deposition of free sulphur, as shown, is all that prevents the continued use of the same parcel of oxide for an indefinite period; but a time arrives when this aggregation of sulphur bears such relation to the mass that the necessity for changing boxes becomes more and more frequent, making further use of the oxide uneconomical.

By very ordinary methods of working good oxide can be charged with from 40 per cent. to 50 ppr cent. of free sulphur before being finally rejected, and is rejected only to become the raw material of another industry. With certain modern systems of using oxide the mass may be worked up to contain from 80 per cent. to 90 per cent. of sulphur.

In ordinary practice oxide is removed from the boxes for the purpose of being "revived." This reviving consists in the absorption of oxygen from the atmosphere and the reconversion of the sulphide of iron into oxide, thus:

$$2FeS + O_3 = Fe_2O_3 + S_2.$$

The sulphur thus set free remains in the mass, but only as part of a mechanical mixture and is not chemically combined. In Britain and certain parts of the Continent of Europe the spent oxide is a marketable article to the gas companies, on account of its contained sulphur which is extracted for the manufacture of sulphuric acid.

While the deposition of free sulphur above referred to impairs, and ultimately renders the oxide useless for our special purpose, it helps, although in a very limited and uncertain way, in the removal of bisulphide of carbon as well as the sulphureted hydrogen. That there is an affinity, although a weak one, between free sulphur and bisulphide of carbon, can be shown by charging gas, which has been already freed from CO_2 and H_2S, with vapor of sulphide and passing it directly through solid sulphur, when the bisulphide will be found to have been absorbed.

This action is as much a source of danger as profit, however, owing to the very feeble nature of union; the instability of the compounds formed making their decomposition extremely probable, with evolution of H_2S.

Until recently it has been the commonly accepted theory regarding oxide of iron that the hydrated oxide only was any use in gas purification, and that the anhydrous variety was entirely non-effective.

While some few have been bold enough to question the truth of this statement, it is but very recently that Mr. John T. Sheard, of England, has, by a series of carefully conducted experiments, demonstrated that the purifying values of hydrated and anhydrous oxides are practically alike; differences in results being attributable to differences of physical or molecular condition rather than chemical constitution. With oxide purification, as with lime, it has been demonstrated that temperature is of the utmost importance, but the best temperature for any given or general set of conditions is still a matter of conjecture.

The absorption of H_2S and other compounds, by either lime or oxide, is a distinctly chemical action, and, since the intensity of such is invariably increased by increasing temperatures, it would seem that the question of temperatures obtaining in our purifying operations presents a fruitful field for painstaking research.

MnO_2, commonly known as "Weldon Mud," has come to the front in the last year or so as a purifying agent. This oxide of manganese is a by-product in the generation of chlorine for the manufacture of bleaching powder; and it is but another illustration of nature's economy in making the by-products (or waste products) of one industry the raw materials or essentials for some other. Weldon mud, like oxide of iron, is susceptible of long continued use by admitting with the gas a regulated quantity of air, and complete revivification by exposure to the atmosphere. It is claimed for this new purifying agent that it is more economical in use than oxide of iron or lime. In one of the largest of the English works it has entirely superseded lime, in spite of the fact that they are operating under very strict legislation as to impurities.

Some experiments carried on at the works referred to demonstrated that, for the purification of 100 million cubic feet, 503 yards of oxide had to be shifted, as against 50 yards of Weldon mud.

Another point in its favor is the fact that, however long in use, it does not give rise to any inconvenience from back pressure; the pressure appearing to diminish with age.

We have now traversed the whole range of operations in the manufacture of coal gas, beginning with the raw materials in the retort and following the products of its distillation through the successive stages of condensation, scrubbing and purification, I have tried to explain and describe the methods of manufacture in common use, the chemical reaction taking place in the various parts of the apparatus employed, and the reasons for the adoption of certain modes of manipulation and the rejection of certain others. My object has been to show how dependent we are on chemical technology for a clear understanding of the actions and interactions of each succeeding stage of our operations, and that,

possessed of this technological knowledge, even in a limited degree, the production of illuminating gas acquires for us an absorbing interest.

While it is true that by chemical technology alone are we enabled to understand the various results obtained, it is not less true that by the same art we are able, largely, to control these results, as it places in our hands a reliable means of acquiring a thorough and systematic knowledge of each step in our progress.

Is it not at least probable that systematic analysis of our liquor and gas, from the hydraulic main on, determining the amount of free and combined ammonia, with the basic acids, and the amounts of the several impurities still contained in the gas, would give valuable information regarding the relative values of coal, methods of purification, or the results to be obtained from any given set of conditions? Such analyses, combined with accurate records of temperature, pressure, and rate of flow would, in my opinion, give ample return for the time spent.

Another matter largely affecting control of results is the quality of our purifying materials. The value of a bushel of lime to the gas maker is not because it contains a definite quantity of material, but because of the amount of real calcium oxide or quicklime which it contains. Commercial limes invariably contain a greater or less amount of matter which is inert or useless for gas purification, such as silica, alumina, sulphate of calcium and magnesium.

Natural limestone is an impure carbonate, and the amount of oxide of lime obtained by burning will be affected in proportion as the burning and subsequent treatment have been good or bad. If improperly burned a large amount of undecomposed carbonate is the result, a material of no value for our purposes.

A moment's reflection on the first cost of lime and the labor in handling will make it apparent that an error here, when a choice is possible, may lead to a serious increase in the holder cost of our gas.

Much the same thing is as true of oxide of iron as of lime; it is only the real ferric oxide that is of any use to us.

Here again chemistry supplies us with an unerring means of determining what is good and what is bad among the materials offered us, in a much more expeditious and satisfactory manner than by spending money and time in continued and disappointing experiments on a practical scale.

Speaking generally of the applications of chemical technology to gas making, I think it of the highest importance that we rid our minds of any idea that we have reached finality; if we do we will deceive ourselves and impair our individual usefulness.

Gas lighting was introduced in the very early years of the present century; but more radical improvements—whether we look to the cheapening of production, or the development of the latent qualities of the product—have been brought forward during the last 15 or 20 years than in all the previous history of the industry, and to-day the master minds in our profession are reaching out to still higher attainments.

In illustration of this proposition it may not be inopportune to review shortly some of the more important changes, viewed from a chemical standpoint, that have come to the front within recent years.

I would first mention the Dinsmore system of gas making, which furnishes a partial answer to the question whether or not any or all of the hydrocarbons in tar can be retained in a permanently gaseous form. While the possibility of converting tar into a permanent luminous gas has been demonstrated, experience with the system has been too limited to give any basis for prophecy as to its future.

Somewhat analogous to the Dinsmore system with its semi-fractional carbonization of tar, is the now almost famous "Peebles" process for the manufacture of oil gas, which is being so extensively adopted in Scotland for enrichment.

This process consists in the carbonization of oil in the retorts in the ordinary manner, washing the evolved gas in oil, which in turn flows to the retorts for carbonization. This oil washing removes certain of the condensable hydrocarbons which are returned to the retorts for conversion into permanent gas, instead of, as in the ordinary system, flowing from the hydraulic main to the tar well.

The results from this method are a quantity of dense, hard coke, and a gas of very high candle power, so permanent that it can be subjected to a temperature far below freezing without loss of bulk or luminosity.

It is universally admitted that ideal purification is that which can be wholly carried on in closed vessels, and in pursuance of this idea several systems have, within recent years, been developed and practiced. A rough classification of the several systems may be made by describing them as the dry and wet ways, there being in each classification rival methods which may conveniently be grouped together for consideration.

The practice of mixing with the gas, where oxide purification is in use, a quantity of air proportioned to the amount of H_2S in the foul gas, has become very common within recent years, and it is needless that I should take up time by explaining the reason underlying the practice.

Objections have been made to the introduction of air in this way because of its well known tendency to destroy the candle power. The introduction of air into an oxide box, however, is not analogous to admitting it into purified gas. If the amount of air is proportioned to the volume of impurity to be dealt with, then the oxygen of the air, so admitted, is entirely absorbed by the oxide, and the inert nitrogen only is left to pass on with the gas.

In order to avoid any deterioration of illuminating power from this source, Mr. Hawkins devised his carbureted air process. This is simply the ordinary air process, with the exception that the air, prior to admixture with the gas, is passed over tar heated to a temperature of about 170° F. By this means a considerable quantity of the vapors of the light and intermediate oils are carried in suspension or positively assimilated by the gas, and the candle power maintained. The other process in the dry way to which I would invite attention may be described as Valon's oxygen process.

The primary idea underlying this, as the other methods, is the revivification of the purifying agent in the box; with this difference, that pure oxygen gas is used instead of common, or carbureted air.

It is claimed for this system that the use of oxygen gives a slightly increased candle power, but whether this generally admitted increase of luminosity is due to oxidation of existing hydrocarbons or simply that the higher temperature obtaining in the boxes, owing to the greater chemical activity of pure oxygen, prevents the deposition of illuminants which in ordinary circumstances would be condensed, is still undetermined.

The oxygen process has the distinct advantage of being applicable to either lime or oxide. The compounds formed by the introduction of oxygen into a lime purifier have not, so far, been clearly defined, but enough is known to show that there is a simultaneous absorption of CO_2, H_2S and CS, and that the sulphur combined as H_2S or CS is not displaced by any subsequent passage of CO_2. This is proved by the fact that when all the lime has entered into combination, CO_2 and H_2S remain constant, the same amounts being found at the outlets as at the inlets of the boxes.

Whatever be the exact chemical structure of the compounds formed, one thing at least is certain, that complete control of sulphur compounds other than H_2S is obtained; 6 to 8 grains per 100 feet being easily maintained. This low figure would seem to indicate the complete absorption of bisulphide of carbon as well as H_2S, leaving only those compounds of sulphur with which no known process is capable of dealing. Sulphur is deposited in the mass in an uncombined state and is reclaimable, as in the case of oxide.

The advantages claimed for this, as compared with any simple air process, are greater certainty regarding "sulphur;" the complete purification of gas by means of lime only; that the lime when removed from the box is perfectly innocuous; that only about one-half the usual quantity of lime is required, owing to the greater chemical activity; and that the purifying area can be reduced about 50 per cent. The successful commercial application of this system depends on the production of pure oxygen at a price that will warrant its use in preference to air.

Oxygen for this purpose is presently obtained by the alternate oxidation and reduction of barium oxide. The oxide is heated in specially constructed retorts, and, on being raised to a high temperature, evolves oxygen previously absorbed by the passage over it of common air when at a low temperature.

Our common air being but a mechanical mixture of oxygen and nitrogen gases, it is somewhat difficult to see why oxygen obtained by the direct admission of air should not do the same work, with either lime or oxide, as that obtained by any special means. I think the very near future will satisfactorily solve this problem. The methods just outlined, while not strictly purification in closed vessels, yet so reduce the materials and labor, as well as lengthen the lifetime of the boxes, that they are rightly considered as long steps towards the desired goal.

We come now to the last class, or wet way. In this classification we have two processes, speaking of either of which it is difficult to say whether their utility or beauty is most to be admired. I refer to Claus' and Young's methods for the complete purification of gas by means of ammonia. These methods do indeed accomplish the purification of gas in closed vessels in the strictest sense of that phrase, and that, too, wholly by its own impurities, and we soar at once from the time-honored and noisome lime heap to chemically precipitated sulphur containing over 99 per cent. of the pure element without a trace of arsenic, carbonate of ammonia and Prussian blue, or sulphocyanide of copper, as by-products of our purification. As in the case of many other revolutions in industries, this is not the product of one brain, but the outcome of the cumulative thought of many minds.

Time will not permit of my giving any detailed description of those processes. I shall, therefore, attempt only a general outline, which I trust will be sufficiently lucid to give a moderately correct impression as to what they consist of.

By the Claus process purification is carried on in a number of towers, variously designated scrubbing, carbonating, heating and distilling towers. The process depends for success on securing a sufficient quantity of ammonia in a gaseous condition to act upon the acid impurities in the gas. This is obtained from the heating and distilling towers by taking advantage in the former of the greater solubility of ammonia than CO_2 or H_2S; such temperature being maintained as will decompose the carbonates and sulphides with the minimum loss of ammonia. The ammonia is set free from the hydrate so formed by means of steam coils in the distilling towers. The free ammonia is then passed into the scrubbers, flowing in a direction opposite to that of the gas. The ammonia in its passage through the scrubbers combines with the CO_2 and H_2S, and the gradually strengthening liquor is pumped from tower to tower until practical saturation is obtained. The foul liquor passes thence to the carbonating towers, where it meets and mingles with the acid gases coming over from the heating towers already referred to. The sulphides in the liquor are here broken up by virtue of the stronger affinity of ammonia for CO_2 than H_2S. The liberated H_2S passes on to the sulphur recovery apparatus, afterwards described, and the excess of CO_2 is removed as solid carbonate of ammonia. The subsequent oper-

ations are the heating and distillation already described. Care is taken, by means of catch towers, that no ammonia is carried off, and the acid gases from the carbonating and heating towers are carried to a kiln, which may be described as a tube packed with oxide of iron maintained at a red heat. A regulated quantity of air is admitted, and the mixed gases and free sulphur vapor are carried forward to a condensing chamber, where the sulphur solidifies. For the removal of bisulphide of carbon the weak liquor from one of the scrubbers is brought in contact with solid sulphur from the kiln, in this way forming polysulphides, which are found to be effectual for the removal of the impurity in question.

You will remember, when speaking of the action of polysulphides in the dry way, it was stated that their action was feeble and unreliable; yet here is a process which depends for success on this very action, and these higher sulphides are found sufficiently stable to do the work.

The spent liquors from the distilling towers contain appreciable quantities of ammonia. This is driven off by means of caustic soda or lime, and the liberated gas returned to the distilling tower. If to the remaining solution a salt of iron or copper be added, the resulting precipitate will be ferro-cyanide of potash (Prussian blue) or sulpho-cyanide of copper.

In Young's process the underlying principle is the same as in that just described; the chief point of difference being in the method of removing bisulphide of carbon. Mr. Young proposes to accomplish this by means of pure hydrocarbons, preferably naphtha, the first distillate of coal tar. Naphtha contains a series of hydrocarbons strictly analogous to those in the gas, where both have been produced from the same coal, and Mr. Young's theory is based upon the fact that the quality of the tar from any given coal will be reflected in that of the gas. In other words, if the gas be rich in any given series of hydrocarbons the tar will be rich in the same series. He has found that if gas be passed over naphtha it will absorb hydrocarbons from the naphtha until saturation is attained, but if a portion of the heavy oils from the tar be mixed with the naphtha there is no such absorbing action, a complete balance being maintained between the gas and the naphtha. If, now, some one or other of the hydrocarbons in the naphtha be removed, the denuded naphtha will absorb from the gas the hydrocarbon of which itself has been deprived, and this action will continue until a balance is again restored. His plan is, then, to free naphtha from its organic sulphur compounds, then expose it (mixed with heavy oils) to the gas, when the organic sulphur compounds in the gas will be absorbed.

The two methods thus roughly described are beautiful conceptions and distinctly within the lines of applied science. They both effect the complete purification of gas in closed vessels, with little labor, and an entire immunity from nuisance of any kind. They both free the gas completely from CO_2 and H_2S, and accomplish a reduction of other sulphur compounds to that limit beyond which or present knowledge does not extend.

Did not the title of this paper confine me to manufacturing operations I might go on indefinitely enumerating points of interest, such as the relative values of hydrocarbons as illuminants; the modes of their formation and their action in combustion; the reduction of candle power by carbonic acid; the causes underlying the formation of naphthaline; the deposition of sulphur compounds by naphthaline; the principle, practice and prospects of incandescent gas lighting; the light giving matter in a gas flame, and its behavior according to the recent brilliant researches of Prof. Lewes, not to speak of innumerable questions relative to our secondary products and their uses, but time forbids.

Much of what I have said, it may be alleged, applies especially to coal gas. It is true. Let me remind you, however, that the essential difference between coal gas and water gas is in the method of manufacture only; and nothing has been said specially applicable to coal gas and the inestimable value of chemistry to its thorough understanding, that may not, with equal force, be applied to water gas. It may be, perhaps, that the raw materials are not of such vital importance in the latter as in the former case, but there is still a wide and varied field for careful and systematic cultivation. When, in the manufacture of water gas, our finished product can be so easily affected by the duration of runs and blows, the quantity and condition of steam, the quality of the coke or coal used in our generators, the specific gravity and constitution of our oils, the temperature and general conditions under which we operate, and the relative amounts of impurities in our crude gas, it will be evident there is no lack of scope for the best energies of each of us.

In conclusion, let me state that I have brought forward nothing new or original, nothing but what, doubtless, is well known to most of you. I have tried to cover, however imperfectly, those points that confront us in our daily practice, for the proper and intelligent understanding of which chemical knowledge is essential, in the hope that by thus grouping them and showing their almost infinite range, a spirit of inquiry and research may be aroused.

Let us not be discouraged by failure in any experiment or set of experiments. Proficiency can come only by practice and careful attention to detail. There is no royal road to chemical knowledge and expert analysis; they are to be acquired only by patient, persevering toil.

There is nothing in the study of chemical science that need dismay any man who starts out with the determination to succeed. Let us each in his place remember that he is the representative of a business almost universal in its scope and interests, and that a corner of the vineyard has been committed to his care. It is surely our reasonable service, then, to see to it that (if we cannot increase the sum of knowledge) that available is not allowed to become meaningless jargon to us from lack of interest.

I do not wish to advise any course of reading or study covering the whole realm of chemical philosophy, nor do I wish to deter anyone from undertaking such. The more we read and assimilate, the better rewarded we will feel for our trouble. We are busy men, however, and, failing the wider knowledge, let us strive to grasp and master that which lies to our hand pertaining to everyday duties. A few books well selected and carefully studied, if productive of no other result, would at least widen our field of thought and observation. In this connection permit me to urge that we keep ourselves fully abreast of the current thought and practice of our profession as set forth from week to week in the technical journals. I do not insist on this from the low standpoint of mere duty, but because, if neglected, a great amount of knowledge which is useful, interesting and even essential will be missed; knowledge which to be without argues something approaching indifference. In these days, when such great versatility is demanded of men, a successful all-round gas engineer is a compound hard to analyze and resolve into his essential elements; but let us not forget that gas manufacture, from the initial to the final stage, is a distinctly chemical operation, and the more intimate our knowledge of the science of chemistry the more absorbingly interesting will our daily work become; the more vigilant will be our care that we are securing these results which modern research has shown possible; and the higher will be the place occupied by gas manufacture and its representives among the world's industries.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Mr. John Collins, formerly in charge of the Rutherford and Boiling Springs (N. J.) Gas Company, has been appointed Superintendent of the Port Jervis (N.Y.) Gas Company.

Mentioning Rutherford puts us in mind of the fact that the Borough Council thereof has again awarded a contract for the public lighting of Rutherford and Boiling Springs to the local electric lighting company, which is to be paid at the rate of $18 per lamp per year, the understanding being that the lamps (incandescent) are to yield a light of 25-candle power, the total burning hours for the year to equal 3,200. Perhaps the agreement would be fair enough to the taxpayers did the lights yield the candle power specified; but if one is to judge the Company's future performance by its past service (the streets have been illuminated some time back by lamps of the stipulated candle power), we have only to say that the taxpayers will be lucky if they secure a service amounting really to 16-candle power on the average per lamp—indeed, we are positive that the average during 1893–4 under the old contract was well short of the candle value stated.

The proprietors of the Consumers' Gas Company, of Woodbury, N. J., after looking over the various forms of Lowe water gas apparatus, constructed by various builders, have contracted with the United Gas Improvement Company for one of its standard double superheating settings, the same to have a capacity of 100,000 cubic feet per 24 hours.

The testing station for the determination of the candle power and purity of the gas supplied in Detroit, Mich., has been completed, and the Inspector (Mr. Chas. Krecke) will soon be heard from in the presentation of official figures.

The following proposition recently submitted to the City Council, of Washington, Ohio, by the Washington Gas and Electric Company, was unanimously adopted:

"1. The Washington Gas and Electric Company, for the consideration of $6,000, to be paid to them per year by the city of Washington, Ohio, payments to be made semi-annually, agree to furnish, for a period of six years, from November 1, 1894, 75 arc lights of 1,200-candle power each, for the purpose of lighting the streets, lanes, avenues, alleys, public grounds and other places of said city. All additional lights ordered by Council to be paid for pro rata. (2) The said arc lights to remain where they are now located, to be lighted on an all night moonlight schedule and all dark hours during moon. (3) Deductions for outages shall be at the rate of 3 cents per hour. No account of outages of less than 1 hour."

The above is at the rate of $80 per lamp per year, as under the old contract, but the burning time is increased. An ordinance to regulate the prices which the Company may charge, respectively, for gas and electric lights, from November 1, 1894, to October 31, 1,900, was also adopted, the main provisions of which are appended:

Gas Rates.—To all consumers using over 500 cubic feet per month, for gas engines, manufacturing and fuel purposes, $1.05 per 1,000 cubic feet. To all consumers using 1,000 cubic feet or more per month, for illuminating purposes, measured through one meter, $1.30 per 1,000 cubic feet. To all consumers using gas for illuminating purposes only, $1.60 per 1,000 cubic feet. A discount of 5 per cent. shall be given from the named rates to all consumers paying their monthly bill on or before the 10th of the succeeding month after the gas is consumed.

Electric Rates.—A rate not to exceed 15 cents per 1,000 watts, or

three-quarters of a cent per hour; the lamps furnished to be 16-candle power incandescent—no lamp to use less than 1,000 watts per month, with a discount of 5 per cent. for payment of bills on or before the 10th of the month.

THE Napa (Cal.) Council has awarded a contract for the public lighting, which provides for a mixed system of gas lamps and arc lamps. The Napa Gas Company will maintain gas lamps on the basis of $34 each per annum, the lighting schedule to be all night and every night, and the local electric lighting company is to maintain arcs of 1,200-candle power, on an all night and every night table, for the sum of $240 per arc per annum.

THE Ottawa (Canada) Electric Company has increased its indebtedness by an issue of 5 per cent. bonds, of the total par value of $320,000.

LAST month Mr. William Blinks, President of the Michigan City (Ind.) Gas Company, caused the arrest of Thomas M. Dolan, on the charge of unlawfully consuming the Company's gas in his residence. Defendant, who was arraigned before Justice Corbley, pleaded guilty and was fined the sum of $5, to which costs of the proceeding were taxed, the total penalty amounting to $20.20. Defendant was a consumer of gas in the "regular way" some time ago, but, failing to pay his bills, the meter was removed. He then connected the house riser direct with the street service, with ultimate result above reported. The conviction was secured under a State law, enacted in 1891, which makes it a finable offense (maximum fine, $100; minimum fine, $5) to in "any way tamper with the mains or service pipes of a gas company."

THE Phœnix Gas Company, of Latrobe, Pa., has made many needed improvements on its plant, perhaps the most notable of which refers to the system of receiving and storing its oil supplies. A pipe line direct from the railroad to the storage tank (a new tank of 7,000 gallons capacity has been constructed) has been put down, and the main system has been increased by the placing of about four miles of pipe. The demand for gas steadily increases.

THE Committee on Gas of Philadelphia Councils, in adjusting the schedule of estimates for the Bureau of Gas for 1895, call for a materially increased appropriation in total.

PRESIDENT RUBIRA, of the Mobile (Ala.) Company, reports a great demand in that city for Welsbach lamps, of the incandescent electric bulb pattern in particular. Many of the largest retail establishments in the city are resplendent with the illumination given by the Welsbachs.

THE following notice recently issued by President Dieterich, of the reorganized Lafayette (Ind.) Gas Company, explains itself: "Mr. Dieterich, President of this Company, when in this city last April, in an interview published in the various newspapers on the 14th and 15th of that month, promised that a substantial reduction in the prices charged for illuminating gas would be made when the extensions and improvements on the plant were completed. Since that time the Company has put in a new and complete apparatus at the works, greatly increasing the capacity of the plant. It has piped the town of West Lafayette and will be prepared to deliver gas there to consumers by November 1st. In pursuance of the promises made at that time the rate on all illuminating gas consumed after November 1st, 1894, will be reduced to $1.25 per 1,000 cubic feet, net. This rate will be the same to all West Lafayette, and regardless of the quantity used."

THE Middletown (Pa.) Gas Company has mortgaged its property to the Valley National Bank, of Chambersburg, in the sum of $2,500, the indebtedness to run for one year.

THE new holder recently constructed for the Fulton Municipal Gas Company, of Brooklyn, N. Y.—it is located on a plot bounded by Bogert, Scholes and Meserole streets—with a retaining capacity of 1,500,000 cubic feet, has been put in service. It gave perfect satisfaction from the start.

THE public lighting of Rome (N. Y.) by electricity (arc lights) was awarded to the Rome Gas Light Company for a term of three years, at its bid of 25 cents per arc per night.

THE Ceramic City Electric Light Company, of East Liverpool, Ohio, sustained a serious loss by fire on October 31st. The damage is put at $6,000, and the lighting service of the place was badly demoralized.

MR. S. F. L. FOULGER, Superintendent of Distribution of the Gas Light and Coke Company, of London, England, after an extended probationary trial of the penny-in-the-slot meter, reports that the Company will introduce this system of supply on a large scale—in fact, to all who chose to adopt it. The Company will fit the house of any applicant in its district with pipes, meter, brackets, burners and a cooking stove, without making any charge therefor in a direct manner. The consumer so supplied, however, will be required to pay for his gas at the rate of 81 cents per 1,000 cubic feet, an increase of 12 cents per 1,000 over gas supplied in the regular way.

SUPERINTENDENT ADAMS, in his statement for October, to the Committee on Light, of Richmond (Va.) City Councils, regarding the operations of the municipal gas works, says that during that period 18,137,400 cubic feet of gas were made, against 17,551,400 cubic feet in the corresponding month last year. There were consumed during the month 18,225,829 cubic feet, against 17,556,798 cubic feet in October, 1893.

THE mains of the Braddock (Pa.) Gas and Light Company have been extended to the outlying suburb of Copeland.

MR. ANDREW DE FOREST, President of the New Haven (Conn.) Gas Light Company, recently received the congratulations of his friends, on the occasion of the 50th anniversary of his marriage. Mr. and Mrs. De Forest, at the reception held in their residence on the evening of October 29th, had the satisfaction of "looking over" many members of the De Forest family.

AT a meeting of the Lansing (Mich.) Gas Light Company, the resignation of Mr. E. F. Cooley, as Secretary and Superintendent, was received and accepted, and Mr. L. E. Walker was elected in his stead. Mr. Cooley's other business interests obliged him to sever his relations with the Company.

THE Massachusetts Board of Gas and Electric Light Commissioners gave a hearing some days ago on the petition of the Northampton Electric Light Company for permission to issue the balance of the capital stock of the Company, voted to be issued by the stockholders on January 12, 1888, to the amount of $6,300. Treasurer C. H. Pierce, of the Company, was the only one who appeared. The hearing was continued to allow the Commissioners to visit the plant and to make further inquiries.

WE are in receipt of a copy of the pamphlet recently issued by the National Gas and Water Company, of Chicago, the pages of which are devoted to an exposition of the Rew process, now in successful operation in the thriving settlement of Cicero, on the western boundary of Chicago. The pamphlet is a model in typography and printing, and the illustrations, of which there are many, are simply superb.

The following letter explains itself:

NEW YORK. November 4th, 1894.

To the Editor AMERICAN GAS LIGHT JOURNAL: On page 586 of your issue for October 22d, I find the statement made by Mr. Brophy: "The pressure necessary to produce light in a current containing 50 arc lamps of 2,000 candle power is about 500 volts." I wish to call your attention to the fact that this is an erroneous statement. One arc lamp which is rated at 2,000 candle power takes about 450 watts, and as these lamps run on a current of 10 amperes it is evident that each lamp has a drop of 45 volts. In other words, that 50 lamps on a circuit need a pressure of 50×45, or 2,250 volts, without any further losses in the line.

Yours respectfully, MAX OSTERBERG.

WHILE we appreciate Mr. Osterberg's correction, for the error as a matter of fact was made, it is nevertheless true that the same is due to a typographical error. Mr. Brophy stated that the voltage necessary under the conditions noted would be 2,500, and the "2" simply went astray.

THE annual meeting of the Consumers' Gas Company, of Toronto, Canada, was a very harmonions gathering, and the annual report showed that despite the dull times the gas sent out in the last twelvemonth exceeded that distributed for the twelvemonth preceding it by a fair amount. The average price received for all gas sold last year was 98 cents per 1,000 cubic feet, the increase in the use of gas for fuel being very marked. The Directors chosen were: Samuel Alcorn, James Austin, M. Baldwin, G. S. C. Bethune, Henry Cawthra, S. R. R. Cockburn, I. C. Gilmor, George Gooderham, James Scott, L. W. Smith, Thos. R. Wood and Sir Frank Smith. The Directors subsequently elected the following officers: President, James Austin; Vice-President, L. W. Smith; Secretary and General Manager, William H. Pearson.

THE Pacific Lighting Company, of San Francisco, has declared a dividend of 30 cents per share (for the month of October), payable on and after November 5th.

THE Edison electric plant at Hackensack, N. J., was destroyed by fire on the 6th inst. Damage, $25,000.

The Market for Gas Securities.

The feature this week in the city market for gas shares was a sharp rise in Consolidated, which opened this morning (Friday) at 123½ bid, offered at 124. This is an advance of five points, and we confess our inability to assign a satisfactory reason therefor. The result of the elections in this State would seem to point almost to a certainty of the reduction by the incoming legislature of the gas rate in "first-class cities" of this State to $1 per 1,000. However, time alone will tell; the present fact is that values of city gas shares are increasing. An error was made in our statement last week that the Mr. Wilson who succeeded Mr. McMillin in the Presidency of the New York and East River Gas Company was the latter's partner. The new President of the Company is Mr. R. T. Wilson, who is undoubtedly a strong man in New York's financial circles. The Brooklyn situation is unchanged, and quotations for the shares are nominal. Consumers, of Jersey City, is bid for at 67, holders asking 73, and the bonds are 93, bid. Bay State gas is strong, at 26¾ to 27, and Laclede's are all higher. Baltimore Consolidated is 68, bid. An official quotation for Cincinnati Gas Light and Coke is 202 to 204.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks.

16 Wall St., New York City.

November 12.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	123½	124
Central	500,000	50	103	—
" Scrip	220,000	—	100	—
Equitable	4,000,000	100	170	175
" Bonds	1,000,000	—	106	108
Metropolitan, Bonds	658,000	—	108	112
Mutual	3,500,000	100	147	150
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	—	—
" Bonds	150,000	—	—	100
Richmond Co., S. I.	348,650	50	50	—
" Bonds	100,000	—	—	—
Standard Gas Co—				
Common Stock	5,000,000	100	37	40
Preferred	5,000,000	100	81	85
Yonkers		50	112	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	111	113
Citizens	1,200,000	20	50	—
" S. F. Bonds	320,000	1000	—	101
Equity Gas Light Co.	2,000,000	100	—	—
Bonds	1,000,000	—	—	—
Fulton Municipal	3,000,000	100	150	155
" Bonds	300,000		103	—
Peoples	1,000,000	10	75	—
" Bonds (7's)	368,000	—	100	—
" " (6's)	94,000	—	98	100
Metropolitan	870,000	100	145	—
" Bonds (5's)	70,000	—	—	155
Nassau	1,000,000	25	172	—
" Ctfs	700,000	1000	99	100
Williamsburgh	1,000,000	50	175	—
" Bonds	1,000,000	—	107	110
Out of Town Gas Companies.				
Bay State Gas Co.—				
Stock	5,000,000	50	26¾	27
Income Bonds	2,000,000	1000	44	45
Boston United Gas Co.—				
1st Series S.F. Trust	7,000,000	1000	80	83
2d " " "	3,000,000	1000	59	—
Buffalo Mutual, N. Y.	750,000	100	120	—
" Bonds	200,000	1000	95	100
Chicago Gas Company.	25,000,000	100	76¼	76½
Chicago Gas Light & Coke Co.—				
G't'd Gold Bonds	7,650,000	1000	81⅛	81½
Consumers Gas Light Co., Jersey City	2,000,000	100	67	73
Bonds	600,000	1000	93	98
Cincinnati G. & C. Co.	7,000,000	100	202	204
Consumers Toronto	1,600,000	50	184½	187
Central, S. F., Cal			90	100
Capital, Sacramento, Cal			—	55
Consolidated, Balt.	11,000,000	100	68	68½
" Bonds	6,400,000		107	107½
Citizens Gas Lt. Co., Rochester, N. Y.	500,000	—	85	101
Bonds	250,000		—	—
Detroit Gas Co.—				
Con. Bonds	.....	.....	—	50
East River Gas Co., Long Island City	1,000,000	100	20	22
Preferred	.....	.....	37	40
Bonds	500,000	100	83	85
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1000	—	101
Hartford, Conn	750,000	25	120	128
Jersey City	750,000	20	190	200
Louisville, Ky	2,570,000	50	125	130
Laclede Gas Light Co. St. Louis, Mo.—				
Common Stock	7,500,000	100	20¾	21
Preferred "	2,500,000	100	78	—
Bonds	9,034,400	1000	88¾	89
Little Falls N. Y.	50,000	100	—	100
" Bonds	25,000	—	100	103
Montreal, Canada	2,000,000	100	200	208
New Haven, Conn		25	200	—
Oakland, Cal			42⅜	43
People's Gas and Coke Co., Chicago—				
1st Mortgage	2,100,000	1000	—	108
2d "	2,500,000	1000	104	105
Peoples, Jersey City	500,000	—	175	185
" " Bonds			—	—
Paterson, N. J		25	99	102
Rochester, N. Y		50	80	85
Preferred			90	95
Bonds			90	95
Syracuse, N. Y	500,000	25	—	—

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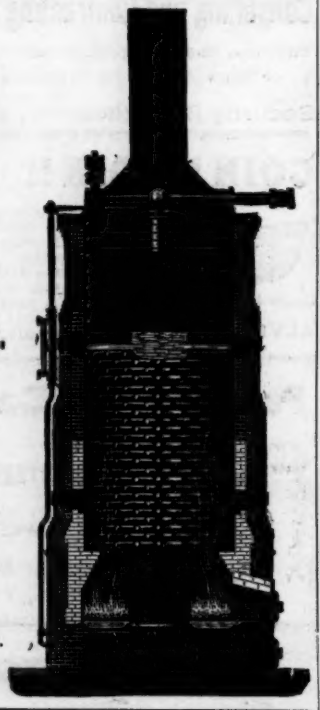

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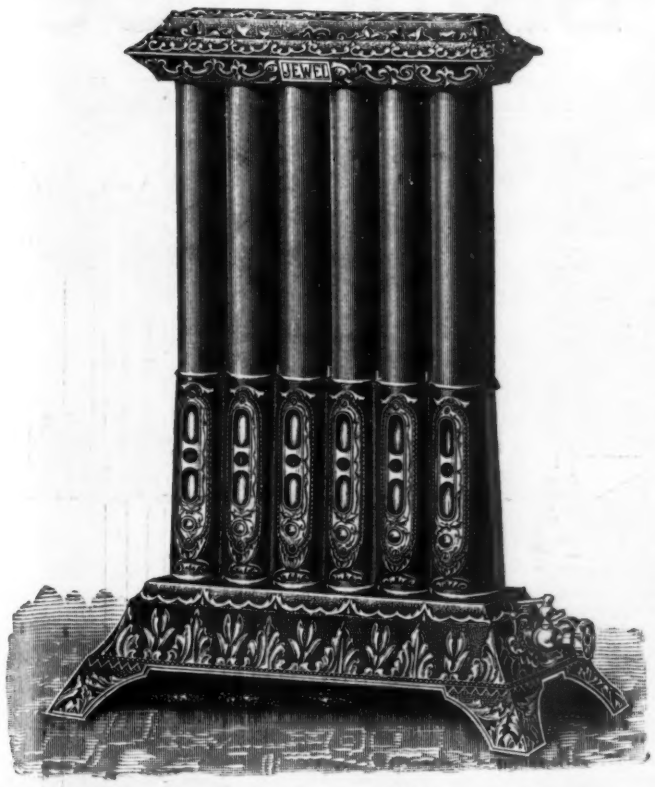

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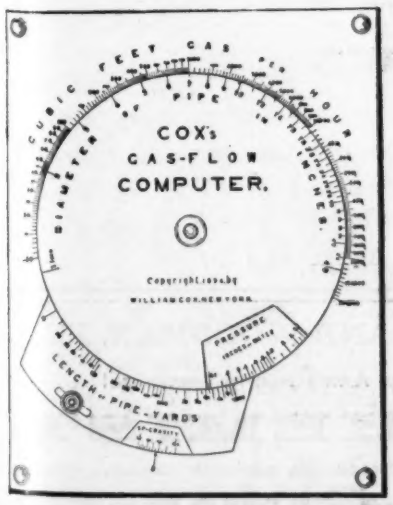

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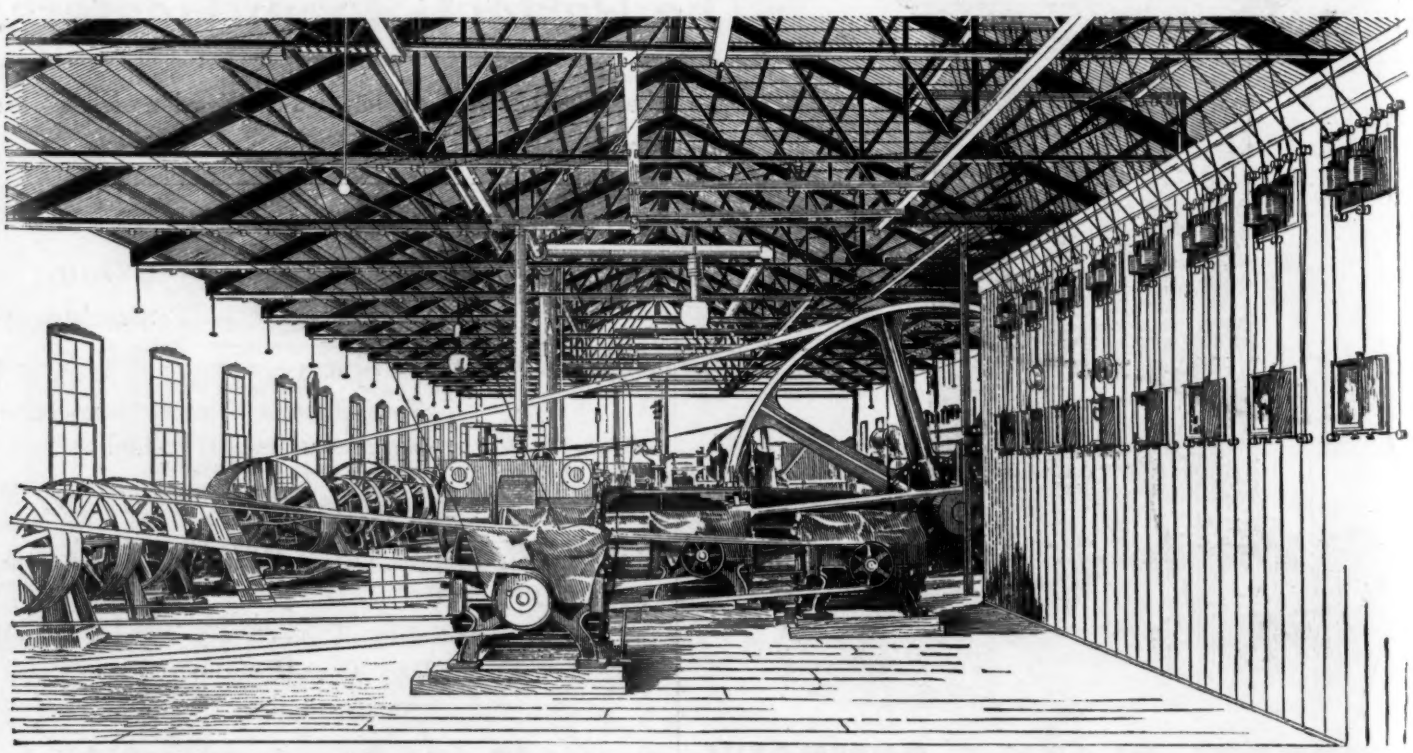

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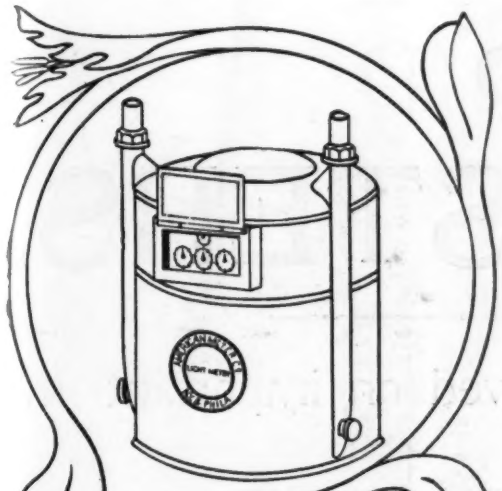

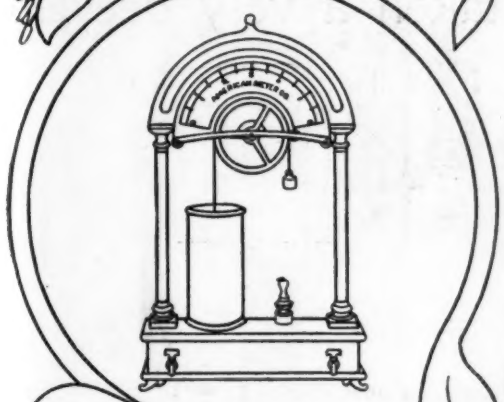

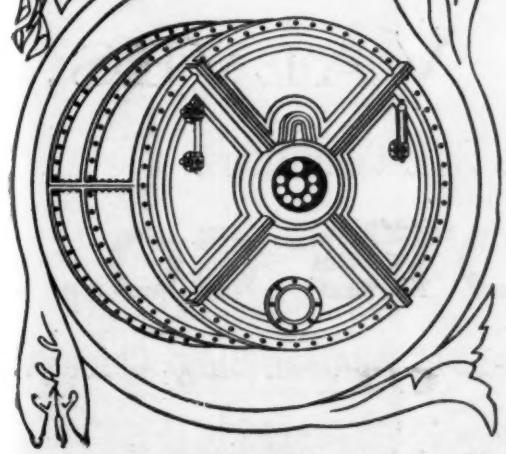

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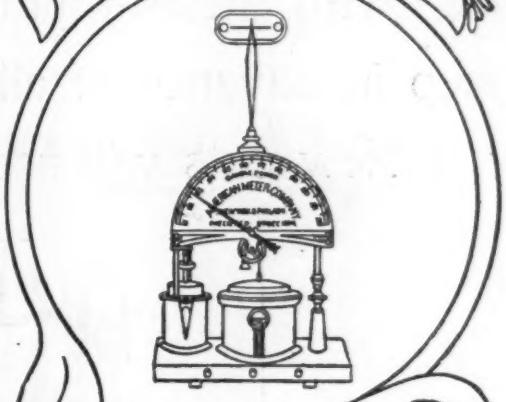
PUBLIC LIGHTING TABLE.

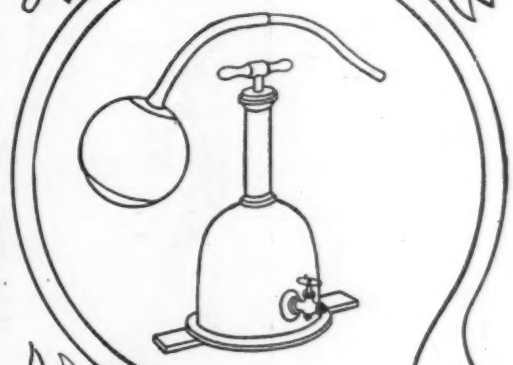
NOVEMBER, 1894.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Thu.	1	5.30 PM	5.30 AM	4.45	5.35
Fri.	2	7.20	5.30	4.45	5.35
Sat.	3	8.20	5.30	4.45	5.35
Sun.	4	9.20	5.30	4.45	5.35
Mon.	5	10.30 FQ	5.40	4.40	5.45
Tue.	6	11.30	5.40	4.40	5.45
Wed.	7	12.30 AM	5.40	4.40	5.45
Thu.	8	1.30	5.40	4.40	5.45
Fri.	9	2.40	5.40	4.40	5.45
Sat.	10	3.50	5.40	4.40	5.45
Sun.	11	No L.	No L.	4.40	5.45
Mon.	12	No L.	No L.	4.30	6:00
Tue.	13	No L. FM	No L.	4.30	6.00
Wed.	14	5.10 PM	6.30 PM	4.30	6.00
Thu.	15	5.10	7.30	4.30	6.00
Fri.	16	5.10	8.30	4.30	6.00
Sat.	17	5.10	9.50	4.30	6.00
Sun.	18	5.10	11.10	4.30	6.00
Mon.	19	5.10 LQ	12.20 AM	4.25	6.00
Tue.	20	5.10	1.30	4.25	6.00
Wed.	21	5.10	2.40	4.25	6.00
Thu.	22	5.10	3.50	4.25	6.00
Fri.	23	5.10	5.00	4.25	6.00
Sat.	24	5.10	6.00	4.25	6.00
Sun.	25	5.10	6.00	4.25	6.00
Mon.	26	5.10	6.00	4.20	6.10
Tue.	27	5.10 NM	6.00	4.20	6.10
Wed.	28	5.10	6.00	4.20	6.10
Thu.	29	5.10	6.00	4.20	6.10
Fri.	30	5.10	6.00	4.20	6.10

TOTAL HOURS LIGHTING DURING 1894.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	244.10	January	423.20
February	195.30	February	355.25
March	206.20	March	355.35
April	169.40	April	298.50
May	162.10	May	264.50
June	135.40	June	234.25
July	146.30	July	243.45
August	162.20	August	280.25
September	174.10	September	321.15
October	211.20	October	374.30
November	221.00	November	401.40
December	245.30	December	433.45
Totai	2274.20	Total	3987.45





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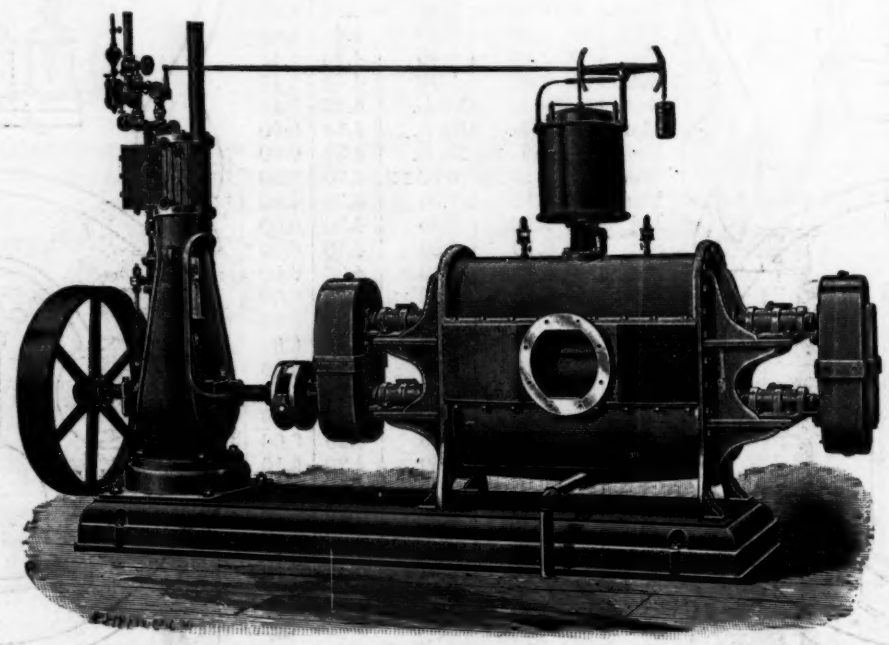

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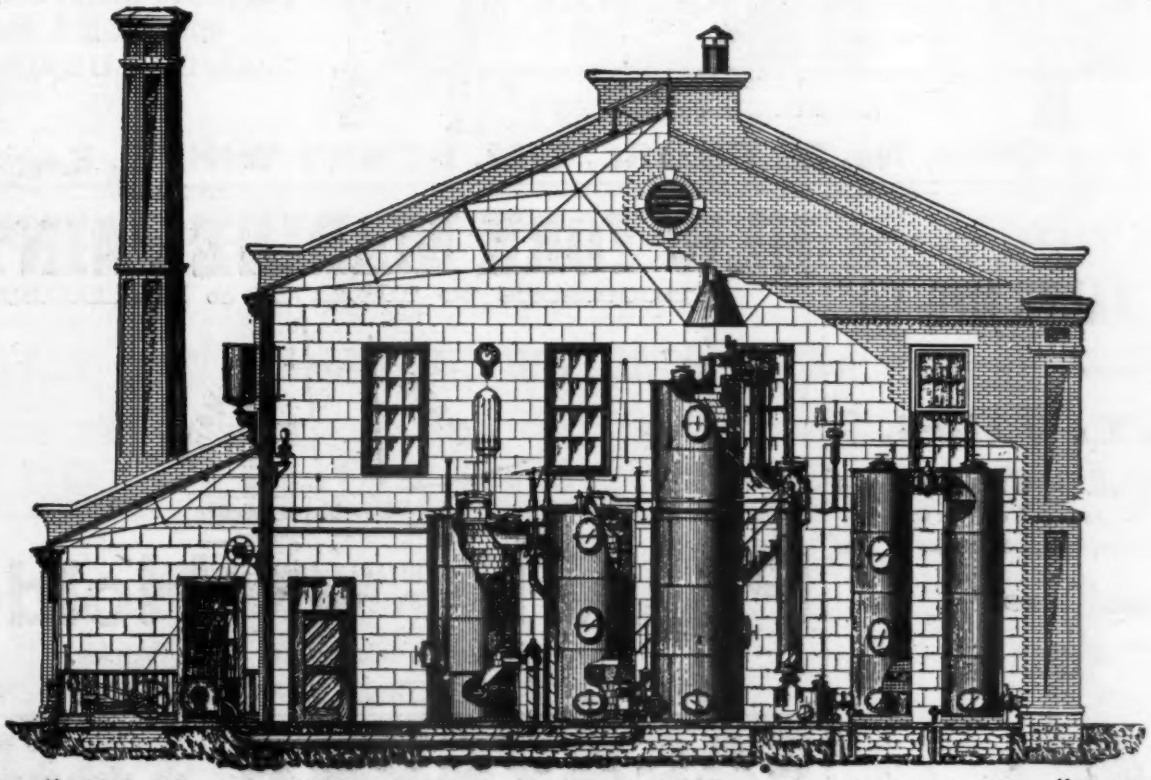

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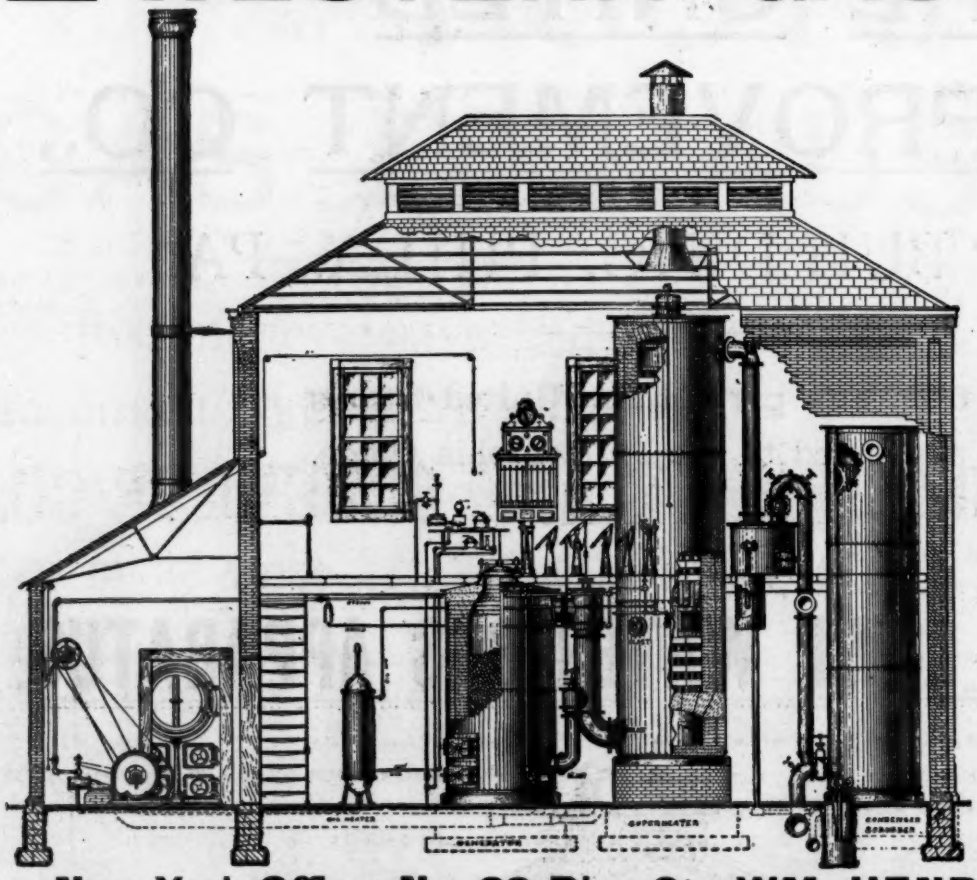

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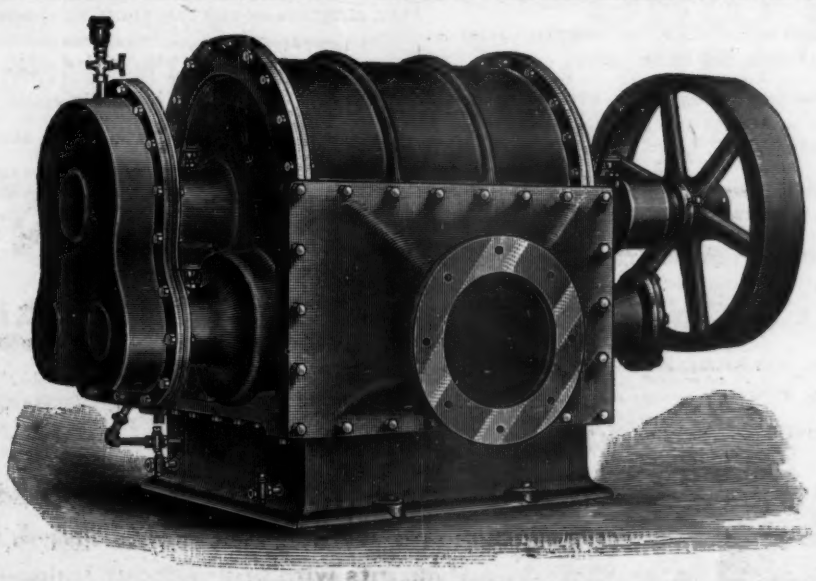

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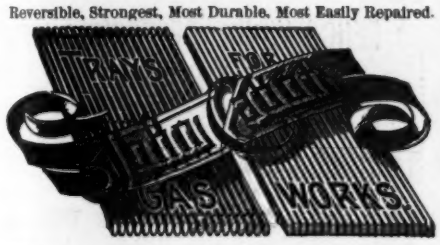

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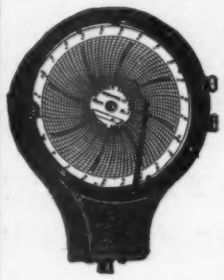

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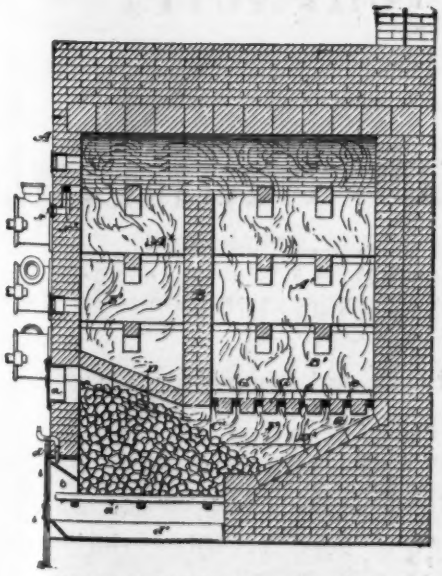

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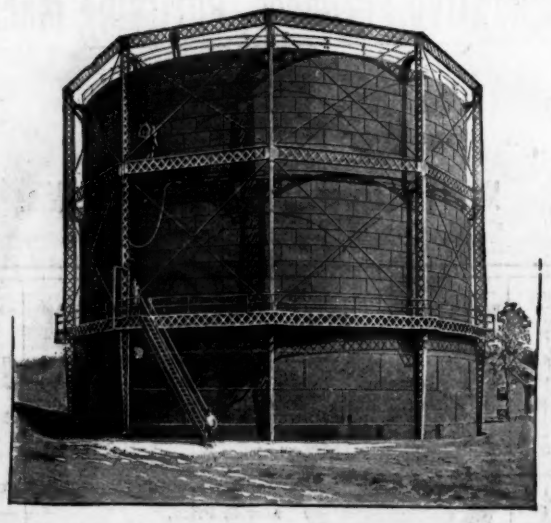

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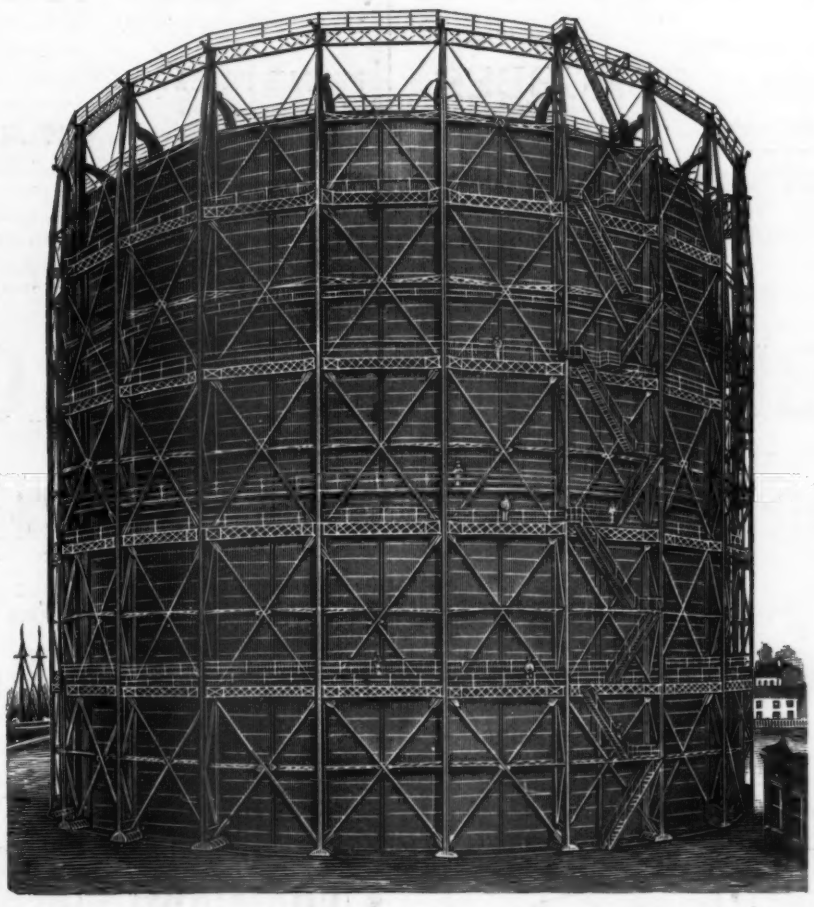

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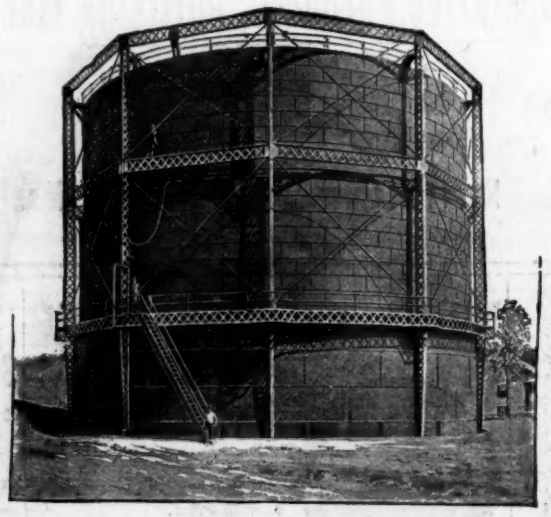

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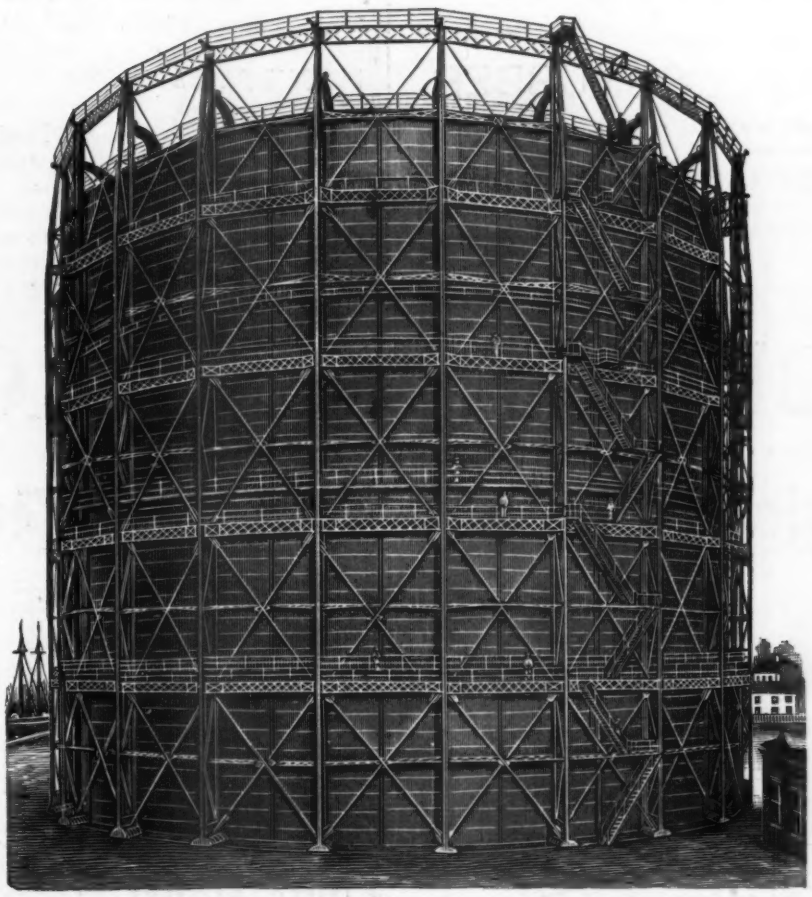

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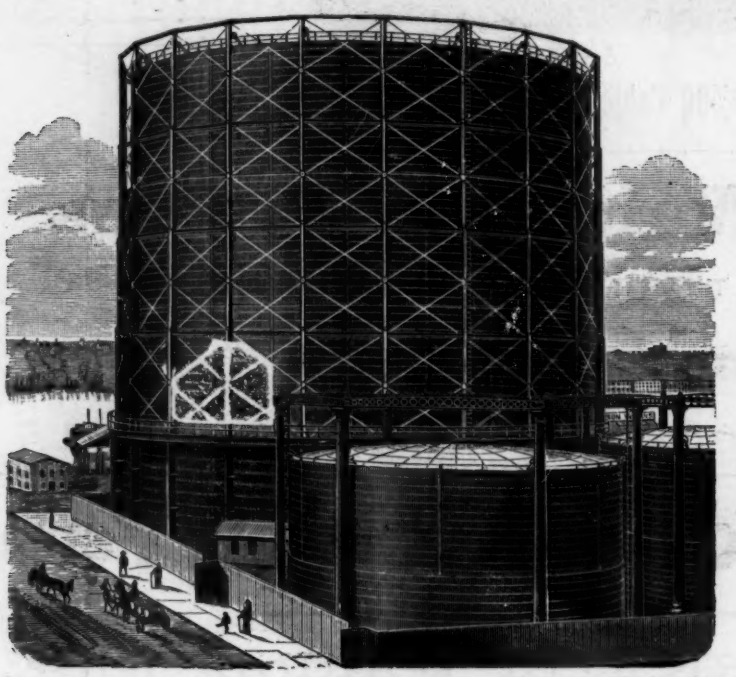

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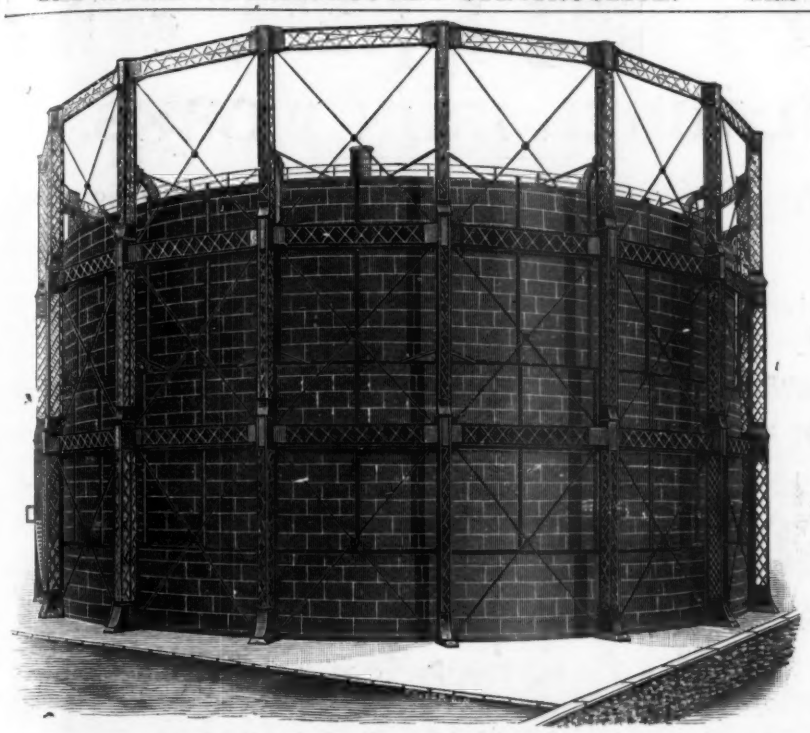

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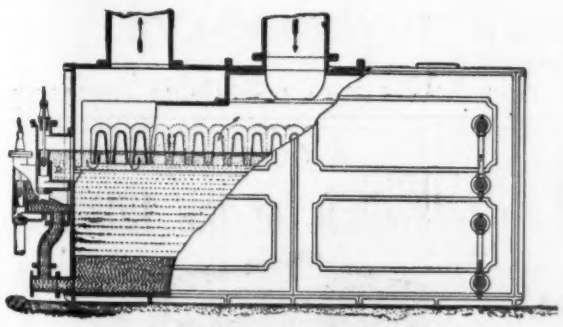

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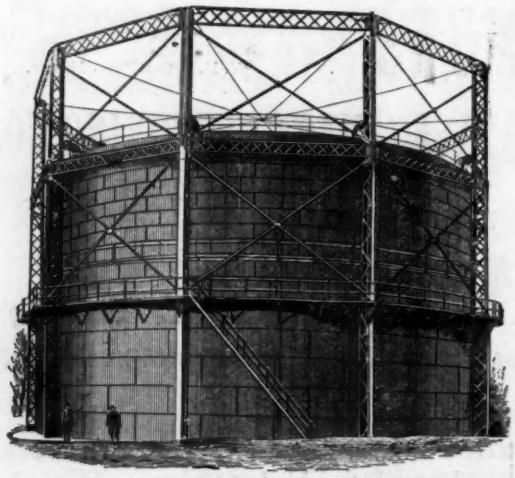

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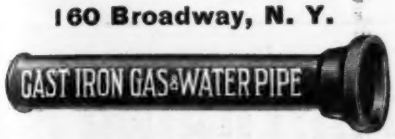

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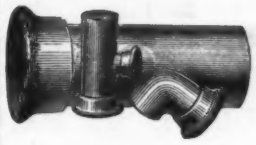

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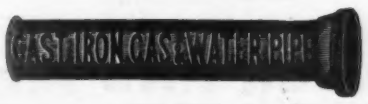

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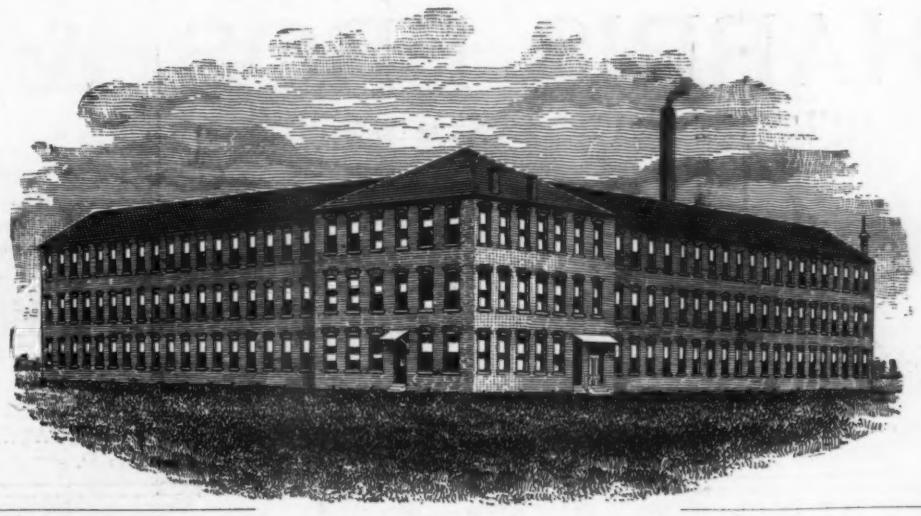

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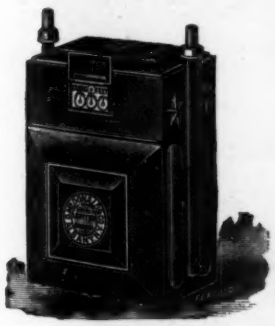

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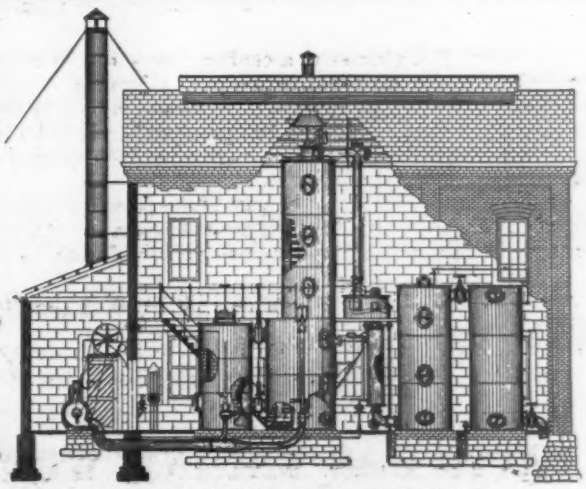

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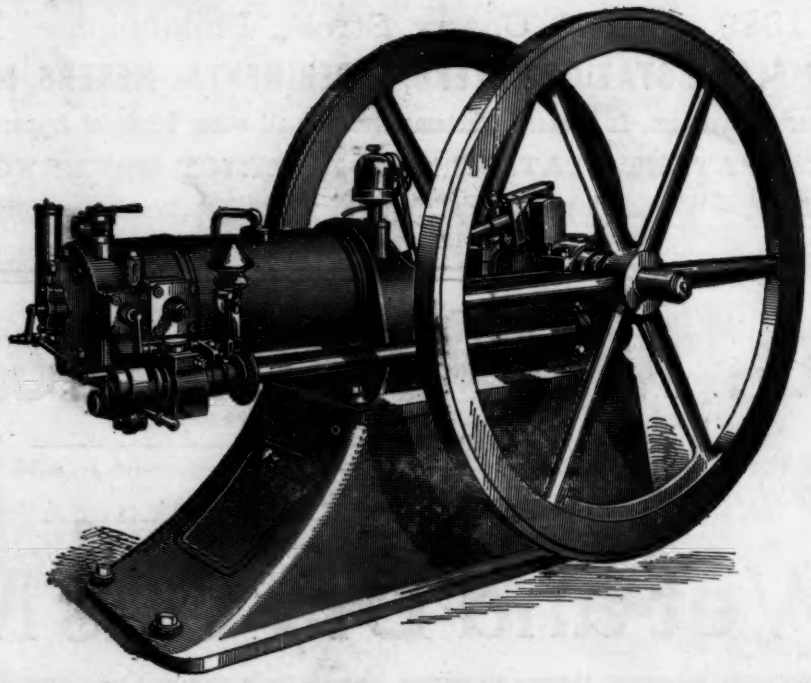

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